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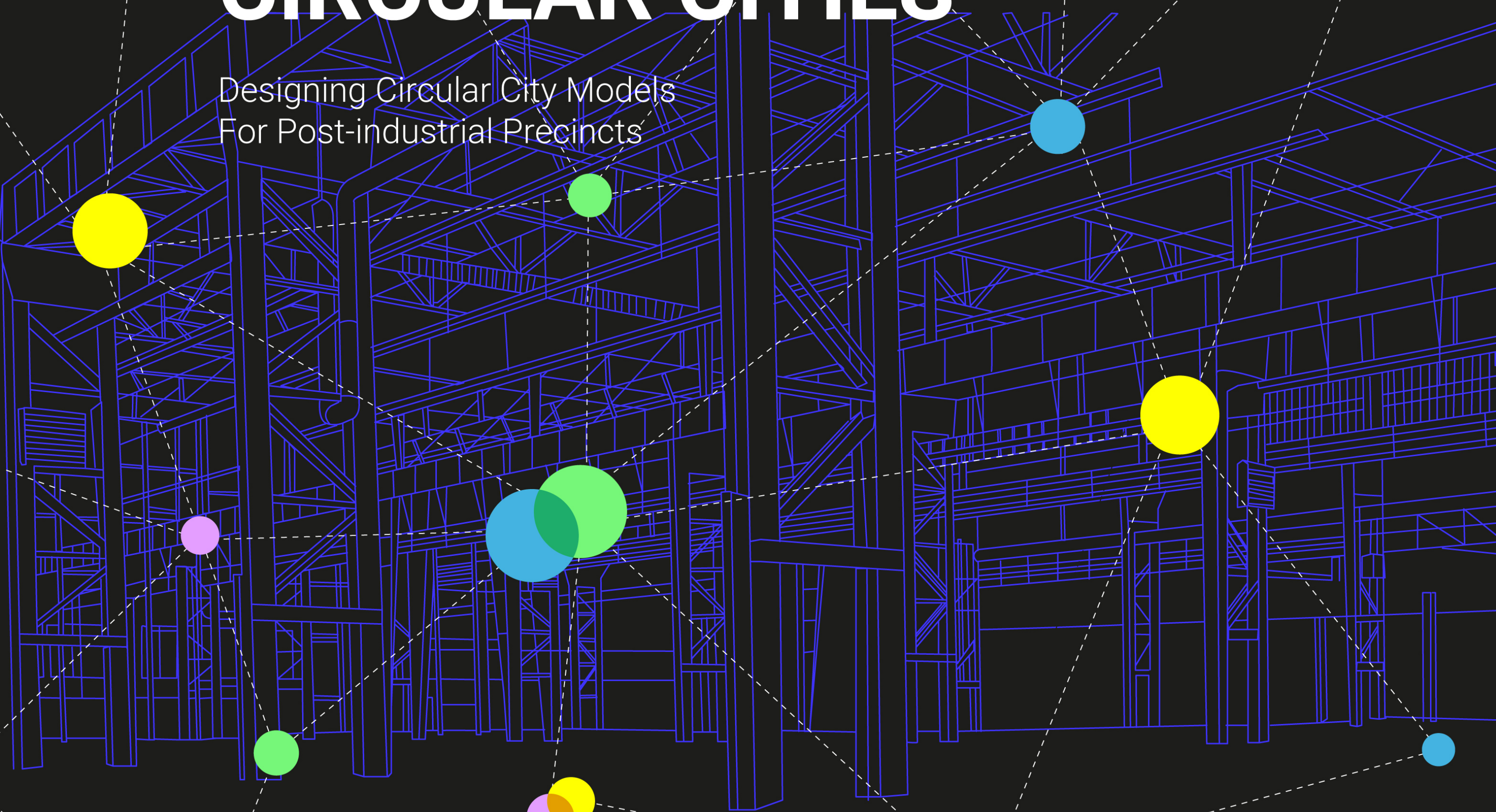
Doctoral Program in Management, Production and Design
33th Cycle

SYSTEMIC DESIGN FOR CIRCULAR CITIES

Designing Circular City Models For Post-industrial Precincts



By Carolina Giraldo Nohra

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Systemic Design for Circular Cities

Designing Circular City models for post-industrial precincts

By
Carolina Giraldo Nohra

—
Supervisor
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TBC

Politecnico di Torino
2020

To the bravest woman I know
la Mamma

Declaration

I hereby declare that, the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

Carolina Giraldo Nohra
2020

*This dissertation is presented in partial fulfillment of the requirements for **Ph.D. degree** in the Graduate School of Politecnico di Torino (ScuDo).

Aknowledgement

This doctoral path is not merely a personal achievement, but a transformative journey of professional and personal life experiences, which I had the privilege to share with my teammates, mentors, research colleagues, family, and friends, wherever you are across the globe, this research is dedicated to you.

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Abstract

The research explored how a Systemic Design approach can support a Policy Design process on Circular Economy towards a Circular City model in post-industrial precincts. The thesis argues about how Circular Economy (CE) policy-making has wicked scenarios, that are often reinforced by a linear model of governance. Allowing "wicked problems" to be locked into "silos", narrowing the understanding of the complex nature of such systemic problems. Therefore, to achieve a transition of CE in cities, it is needed a radical shift towards a more adaptive and collaborative policy framework. On that perspective, city governments approach CE policy instruments that enhance local value which is cohesive with long-term environmental goals of a Circular City. In particular, this doctoral research is focused on three research questions: What Circular City model can be envisioned post-industrial precincts, and what are the challenges and opportunities for their transition?, In what ways a systemic designer can co-design policies for a post-industrial precinct that encourage their transition towards Circular City? and, What value can Systemic Design approaches bring to the field of Public Policy on CE in cities beyond the scope of post-industrial areas?

The first Chapter delivers an overview of the background of this research applied to cities with post-industrial precincts, their CE challenges and the role of the designer in crafting effective policy-making process. On the one hand, the interest in post-industrial precincts was documented. Through their evolution from deprived areas towards 'hubs' for radical innovation and thriving resilient precincts, underlining their wicked problems in the governance and linear economy to be able to reactivate these precincts resides. This panorama was followed by a CE introduction and how such an approach is critical to unlocking the wickedness in post-industrial precincts. For that aim, it presents the need to propose effective policy strategies to transition towards a CE creating new socio-technical systems. Therefore, the discussion is narrowed towards the need of the conceptual framework of a Circular City which delivers an overview from which to comprehend the ways CE could policies demonstrate in an urban environment. Such a model requires an innovative model of governance and decision-making, combining top-down and bottom-up processes. In order to activate new mechanisms of decision making, such as design thinking, participatory, and systemic approach towards co-design policies for a Circular City model. On that view, the Systemic Design has introduced as crucial expertise which provides practical tools to approach complex scenarios, in this case, addressing a CE policy design process in post-industrial precincts.

The second Chapter presented a state of the art reviewing the literature on System Transitions, Design for Sustainability, Systemic Design, Co-design practices, CE Policy Design and identified a knowledge gap. Such examination contributed to setting the scope of this research around CE policy design and outlining the problem to be investigated, the need to investigate in which ways a Systemic Design approach to CE policy cycles can establish a more inclusive and cohesive policy design process for a circular model relationship with the context to develop local value. As an outcome, a Systemic Design lens on Policy Design for CE decision-making was drawn as a conceptual approach to inform the following phases of this examination.

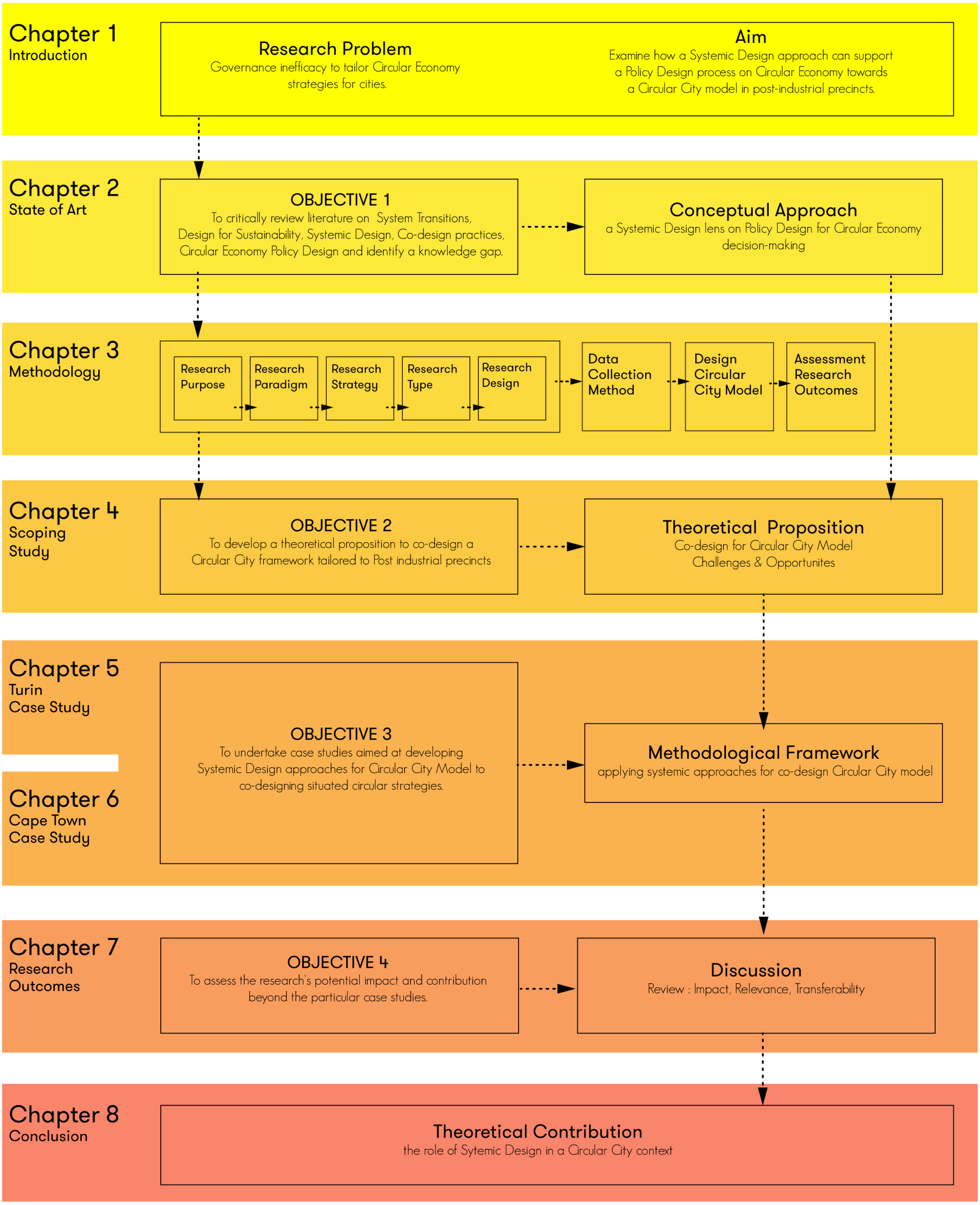
The third Chapter introduces the research methodology of this investigation; it describes the exploratory purpose, pragmatist paradigm and the mixed-method type of this research. Moreover, it explains the intended research strategy through the choice of case studies. This section describes in detail the research design, including data collection methods from Literature Review to the Systemic Design methodology determined to address the research aim and objectives drawn in section. Also, is delivered a further discussion on the selection of data collection and analysis methods applied in this research process.

The fourth Chapter presented the scoping study which was framed by a specific literature review targeting the evolution of the Circular City model carried to reach a theoretical proposition on Systemic Design approaches for a Circular City Framework, as set out in the rest of this Chapter. For that aim, the literature review from the urban sustainability background to the currents models around the Circular City. Ultimately, the researcher carried a method of design synthesis of the outcomes into a theoretical proposition to inspire a Circular City Framework on the lens of Systemic Design for post-industrial precincts. This research outcome complements the Systemic Design methodology as it adds the scope of Circular City model elements narrowing towards a CE perspective for post-industrial precincts. Moreover, the framework delivered a co-design approach to tailor CE strategies that can coexist to deliver social and economic welfare and activate new mechanisms for value creation in post-industrial areas.

The further examination of the proposed Systemic Design Framework for Circular Cities was through the cases study of Mirafiori South Precinct in Turin (Italy) (Chapter five), and Atlantis precinct in Cape Town (South Africa)(Chapter six), which allowed bridging from the theoretical proposition of Systemic Design Framework for Circular Cities to tangible practices co-designing situated circular strategies for decision-making. Both considering post-industrial legacy as a pillar for to generate a Circular City model yet, the nature of both scenarios (Europe/Africa) is radically different which brought to the outcomes a broader and different understanding on how to activate decision-making process to transition into a Circular City model. In both examinations, a Holistic Diagnosis was conducted that deliver a holistic system panorama of all Mirafiori's precinct assets to identify the current local assets from opportunities to challenges as leverages for value creation and co-design the current system based on the conceptualisation of a Systemic approach on Circular City framework in this context. The result of the framework delivered the Mirafiori South Circular City model and the Atlantis. That identified the potential, planned or executed strategies around the main Circular Actions (Regenerate, Adapt, Loop). Also established system dynamics through concrete implementations for each strategy potential or already executed and assess the proposed Circular Actions through the lens of the CE barriers and impact indicators. The results of this study aim to facilitate a better un for the area understanding of the potential CE strategies for a resilient Circular City model on a Global North and South perspective.

On Chapter seven a research synthesis was conducted to assess the case study application aimed to oversee the strengths and challenges of the proposed framework implementation through examining four levels of innovation: technical, social, economic and cultural. Including the issue of 'value creation ' on CE policy-making process by proposing that Circular City model system through anticipatory scenarios, could bring more future-oriented and sustainable-oriented policy actions to enhance local value creation. Also, the assessment of the examination findings on Systemic Design capability to navigate this wicked scenarios aiming to maximise the value of government tackling and be supportive in CE policy foresight practices and strategic decision making in cities.

The last Chapter presents how the research aim and objectives were reached, and a conclusive overview of the doctoral research. Moreover, it displays the primary contributions of this research to the systemic design discipline. Ultimately, it addresses the limitations regarding the research and proposes recommendations for further research.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Aim
Examine how a Systemic Design approach can support a Policy Design process on Circular Economy towards a Circular City model in post-industrial precincts.
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Chapter 1

Introduction

This Chapter introduces an overview of the context and background of the research problem. Then sets the pillars of the investigation development from the aim, objectives and research questions, to the scope and direction of the study.

1.1. Research Background

Today, through times of frenetic change, the world is experiencing the growth of interconnected megatrends. This increasing discussion of a state of complexity, described in reports such as (PWC, 2017) includes radical transitions as; economic power, accelerated urbanization, climate crisis, resource scarcity, technological breakthroughs, and erratic social transformations. Consequently, this phenomenon has brought many increasingly pressing challenges threatening the city's wellbeing and economic prosperity. Proving that today more than ever, the world is rapidly going towards several tipping points as humanity is consuming the equivalent of 1.7 Earths (UN, 2018). Over the years, our economy has evolved into a global multidimensional process that has manifested itself in cities through radical changes in human population densities and urban fabric. Such transformations are so rapid that not all cities can cope with the demands of the market and population. This drastic shift has left many formerly manufacture/extractive or Fordist cities with the deprived and outdated urban fabric; this has resulted in the rise of post-industrial precincts (ICLEI, 2018). Such megatrends already are having several implications on the ways our cities consume, certainly shaping the types of products, services, and technologies that will be designed, developed and used in the future.

Nowadays, cities are witnessing an increased interest in Circular Economy policies as an essential model of design, production and consumption, contributing to sustainable development and wellbeing. Such phenomena present an opportunity for design discipline to intervene decisionmaking process and co-design policies that activate innovative paths towards a Circular City model. The upcoming sections deliver an overview of the background of this research applied to cities with post-industrial precincts, their Circular Economy challenges and the role of the designer in crafting effective policy-making process (Figure 1.1).

THE CONTEXT OF POST-INDUSTRIAL PRECINCTS

More and more, in the current globalised linear economy, cities are affected by the rise of resource consumption which is exceeding planetary boundaries (IRP, 2019). Several sources have highlighted the increasing interest in post-industrial precincts across social, environmental and economic sectors (ICLEI, 2018). In the past, these precincts flourished socially and economically due to stable industrial relations, which delivered social welfare and local consumption systems (Kazepov, 2005). These upcoming industries based on "Fordist cities" witnessed an accelerated development of industrial infrastructure such as; factories, warehouses, railroads, and harbours, parallel to this came the

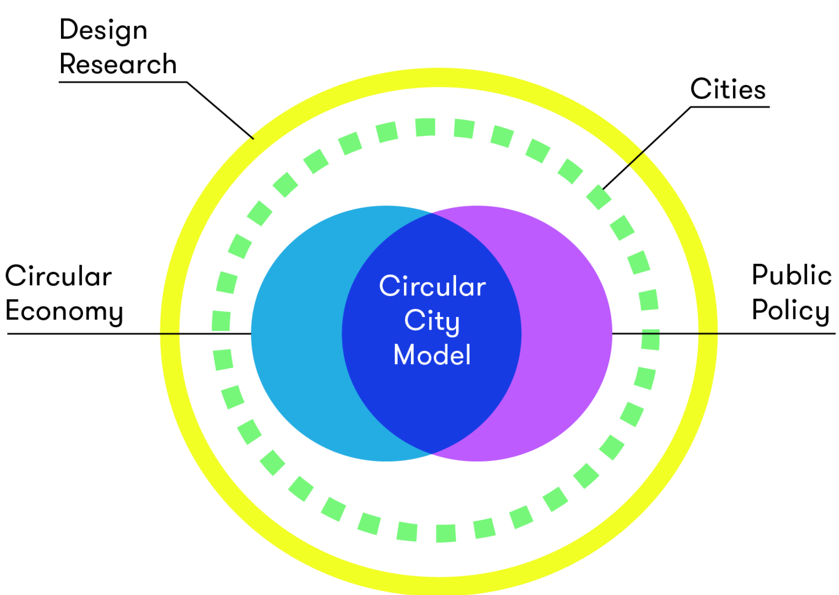


Figure 1.1 Focus of the study. A design research approach to deliver a Circular Cities model

massive development of social welfare facilities such as housing, schools and recreational areas (Cucca & Rancci, 2017).

As global economic trends evolve in the last 30 years towards a dematerialised/service-based economy, these Fordist cities suffered the negative consequences of this brutal shifts. From a market demand perspective, these precinct's urban fabric could not cope with the transitioning industry, generating economic recession, rising unemployment, and population decline. As a result, this flourishing neighbourhoods turned into desolate areas with predominantly brownfields and outdated urban fabric. Over time, this phenomena highlighted the trend on the disconnection between economic growth and social welfare (Cucca & Rancci, 2017). Such accelerated changes lead to acknowledging these urban environments as challenging precincts to address sustainable development issues (Bulkeley et al., 2011).

Many post-industrial precincts face the pressing of revamping infrastructure and services to meet their current and future needs. So, to surpass the systemic outcomes of deindustrialisation, these areas must re-frame their urban identity in order to boost urban transitions on restoring sustainable livelihoods (ICLEI, 2018). Other scholars have underlined that to support such post-industrial legacy it must be approached as 'hubs' for radical innovation towards thriving resilient cities (Ernstson et al., 2010; Bulkeley & Broto, 2012). However, the challenge to reactivate these precincts resides in the governance, as some city policies insist on overviewing this matter as revamping or regenerating meer physical infrastructure, a view that keeps delivering deprived areas. Currently, most of the literature is still acknowledges that "Cities are not actors; they are places where people and economic activities are concentrated; complex social, economic and physical systems" (Otto-Zimmermann, 2011). Therefore, it is vital to consider cities as ecosystems that contain individual and embedded systems from three interconnected spheres: the natural, built, and socio-economic environment (McDonnell et al., 2009). This perspective addresses a holistic overview of the geographical and socio-cultural idea of the city, focusing on the dynamic feedback relationship that interacts within the post-industrial precincts and the city ecosystems (Ernstson et al., 2010).

On that view, in this day and age how the post-industrial precincts ensure enough resources, quality jobs and income opportunities in a more humane, sustainable and efficient manner? According to the Sustainable Development Goal (SDG) 11 "Make cities and human settlements inclusive, safe, resilient and sustainable" and SDG 12 "Ensuring sustainable consumption and growth patterns", cities will have

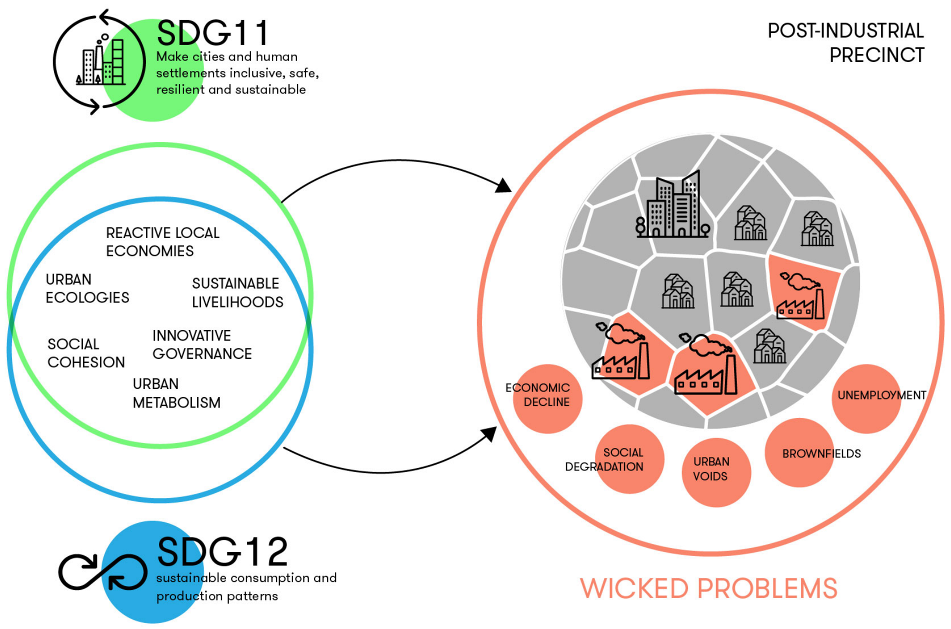


Figure 1.2 Post-industrial precincts on the frame of the Sustainable development diagram developed by the researcher.

to prepare for a long-term transformation towards a Circular Economy in order to overcome the systemic effects of deindustrialisation (Figure 1.2). With this in mind, how post-industrial cities can achieve an overall sustainable and cohesive transition towards a resilient circular scenario, that can reduce future economic, environmental and social costs, but at the same time generate local value?

A CIRCULAR ECONOMY PARADIGM

The phenomena of post-industrial precincts are the result of the current linear economy, which has increased exposure to the risks of unpredictable resource prices, job instability, and supply disruptions. These problems of resources security and scarcity are jeopardising most cities increasing dependence on material imports -six times more material imported than exported- (Lazarevic et al., 2017). Moreover, as local production declines, the situation has gotten sharper as the low costs in production and labour in Asia have put most cities economy at a disadvantage. As a consequence, most cities globally are producing and consuming not local resources in an unsustainable way.

These erratic shifts or - wicked problems - (Rittel & Webber, 1973) are underway on a vast scale with transforming economies, governments and societies in complex, interconnected in unpredictable ways. The nature of such global trends in cities, claim to redesign the current public policy conditions in order to be more future-oriented on the way to sustainable development. The need for and the potential of innovation has never been greater. These situations are complex and interconnected, which means that addressing one could have positive implications towards the others.

So to tackle that wickedness, sustainable development urges the balance the 3 Ps: People, Planet, and Profit (Elkington, 1998) or in the view of James (2015) balance the Circles of Sustainability such as; resilience, liveability, adaptation, innovation and reconciliation. In order to achieve that proportion is required a holistic frame of reference (Hjorth and Bagheri, 2006) which to ensures inter-generational and intra-generational fairness (WCED, 1987). Today this approach to sustainability resembles to be incarnated by the Circular Economy (CE) concept in opposition to the current inefficient linear economy (Murray et al., 2015).

The CE fosters the transition from a linear model towards a more sustainable economy, focusing on the benefit for the environment and the society (EMF, 2015). This concept has an extensive background of scientific fields and concepts that have surrounded it from the begging. These references include, for instance: industrial ecosystems (Jelinski et al., 1992), biomimicry (Benyus, 2003), cleaner production (Stevenson & Evans, 2004), natural capitalism (Hawken et al., 2008), the blue economy (Pauli, 2010), industrial symbiosis (Chertow & Ehrenfeld, 2012), product-service systems (Tukker, 2015), eco-efficiency (Haas et al., 2015) and others. Indeed, these notions have caused an essential contribution to the concept of CE, but the most prominent background concepts have been the concept of "eco-effectiveness" conceived by cradle-to-cradle (McDonough, & Braungart, 2002) and the industrial ecology (Graedel, 1996). Considering this scenario, the definition of the CE concept provided by Korhonen, Honkasalo, and Seppälä (2018) brings a complete perspective of the World Commission on Environment and Development (WCED) :

"Circular economy is an economy constructed from societal production-consumption systems that maximise the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources, and cascading type energy flows. Successful CE contributes to all the three dimensions of sustainable development. CE limits the throughput flow to a level that nature tolerates and utilises ecosystem cycles in economic cycles by respecting their natural reproduction rates".

Such a definition allows understanding the need to propose effective policy strategies to transition towards a CE creating new socio-technical systems. Also underlines the wickedness of such the linear economy, which is complex and interconnected nature. Considering that, the road towards a CE requires a holistic approach perspective, where the depth understanding of the complexity comes from the number of variables and relations created in the environment. Bringing, as a result, addressing one challenge could have positive outcomes towards the others having a systemic solution effect — on that path by 2030, tackling sustainability is a vital consideration in the design and development of products, services, and technologies. Otherwise, if the prevailing consumption culture does not change, CE will remain as a technical instrument that does not alter the current economic paradigm (Korhonen et al., 2018). With this in mind, this research emphasises the constant advocacy for a paradigm change from the traditional linear model to circular economic one at the forefront of the government's agendas.

It is undeniable that the benefits offered by the CE transition are increasingly acknowledged a vast transition is inevitable, and changes are underway on a large scale. Nevertheless, the execution of this potential is hampered by various obstacles barriers such as economic (instability of the market), social (lack of knowledge to distinguish opportunities) and regulatory (policies that inhibit the reuse waste) (EMF, 2015). On that perspective, the nature of CE has been approached in different angles across the globe.

Currently, most of the literature acknowledges that CE in a Global North and EU context is concentrated on waste management through reuse and recycling. Such efforts are narrowed on reducing waste and cost savings; the eco-design guidelines on production systems as well as new business models on remanufacturing and repair (Desmond et al., 2019). In particular, the European Commission (EC) has targeted the CE as one of their main objectives through the settled goals on sustainable development, low carbon targets, and resource-efficiency. To accomplish this ambitious purpose, the EC released the Circular Economy package implemented since 2015, whose aims is through the integration of policy proposals on waste management, landfills, and recycling and reuse, encouraging a shift to a sustainable economic paradigm in the EU in co-creation with economic actors, consumers, citizens and civil society organisations. To achieve plan implementation was set up across the following actions: Circular Design and Production Processes, Empowering Consumers, Turning Waste into Resources, Closing Loops of Recovered Materials, Strategy for Plastics and Bioeconomy Strategy (Figure 1.3). This effort aims at accelerating the shift required by the European Green Deal released in 2019. The first results of these actions are proving that circularity has contributed to the raising of new business opportunities and developed new markets, internally and beyond the EU (EC, 2019). Therefore, it is a chance to foster competitive advantages on a sustainable basis with the potential to create an income benefit of EUR 1.8 trillion by 2030 (EMF, 2015) and over 1 million new jobs across at EU level by 2030 (EPRS, 2017). To that end, the EC has highlighted that "the transition to a circular economy is a systemic change" (EC, 2019) aiming to support roadmaps that promote such goal. Applying CE principles across all sectors and industries within a foresight perspective could imply a decrease in the environmental, social and economic pressures, increasing the EU cities strategic autonomy.

Figure 1.3 European Commission Circular Economy Package

On the contrary CE in the Global South has focused on the rising economy issue as waste management, electronic waste, renewable energy, poverty mitigation and employment creation (Figure 1.4). Their current circular practices are mostly small-scale - e.g. waste collection and recycling, repair, refurbishment and biomass (Gower & Schroder, 2016). Particularly in Africa, the CE has focused on employment and environmental impacts, e.g. the vehicle repair and remanufacturing cluster in the city of Kumasi, Ghana (Schmitz, 2015). Nevertheless, most of the African case studies have remained unknown yet to be documented. As a result, there is a considerable knowledge gap in research on how multinational companies with global value chains can engage with small and medium-sized enterprises in Africa. On the other hand, the impact of Global North CE policies- e.g. EU's CE Package-on the African continent is unknown. As most countries are dependent on the export of natural resources and raw material, this means the African economy will have to enhance their resources locally. However, an early transition to CE in the EU could bring significant benefits to the African continent. For instance, it could shift the panorama in the health sector currently affected by the negative consequence caused by the Global North shipping e-waste in African countries (Desmond et al., 2019).

Around the world, this inevitable transition, we must be aware that not all parties would benefit from a circular model on regards growth and employment (EMF et al., 2015). According to McKinsey (2015), there are non-captured system benefits and rebound effects could limit the income. Moreover, this scenario will bring consequences to a considerable part of the industry and employment segments that will be likely not to act quickly enough and would lose by 2030.

CITIES TOWARDS CIRCULAR ENVIRONMENTS

Cities regarded as living metabolism or a "systems of systems" are on the need to seek for resilience to be able to deal with climate and economic impact. Today, cities consume approximately two-thirds of global energy, generate 80% of greenhouse gas emissions and 50% of global waste. The UN estimates that 66% of the world's population will live in cities by 2050 (UN, 2018). Therefore, bringing positive and negative consequences on cities at a global and local level in aspects such as; natural environment (Grimm et al., 2008; Elmqvist et al., 2013), social and economic (Glaeser 2012) health and wellbeing (Vlahov & Galea 2002). More importantly, such impacts will frame the possibilities for staying within the planetary boundaries (Raworth 2017; Steffen et al. 2015).

Figure 1.4 Repair electronic workshops in Ghana .
Source : African Circular Economy Network

Nowadays, the neo-liberal economic model regards cities as parasites (Odum, 1989) based on a resource consumption model. Targeting these fragile urban systems into the erratic economic changes, in particular, post-industrial precincts an exemplification of those consequences on which this research has focused. In order to tackle climate change and its economic impact, cities should be regarded as complex, dynamic ecosystems or living metabolisms through which resources flow between actors, across multiple scales and sectors (Wolman, 1965). To foster resilience in those scenarios the current model has to shift into a self-regenerative or autopoietic one (Varela & Maturana, 1972) from a consumer to a prosumer city (Tofler, 1980) where the enhanced local assets can generate a sustainable urban system over time.

On that regard, there is continuous support at the frontline of the cities agendas for a paradigm shift on resource management from the conventional linear to CE, as a new socio-economic standard to optimise productions and consumption of goods and services. On that view, the role of cities in the transition to CE will be core as they are responsible for 60% of public investment in most countries (OECD, 2019). As a subnational government, they can favour long-term investment alternatives related to resource management (energy, water, waste). More importantly, promoter, facilitators and enablers for laboratories for innovation and experimentation. This circular approach could serve cities to address the way they produce and consume resources, but also it could decrease waste, greenhouse gas emissions, underutilisation of resources and the decline of urban ecosystem services (Williams, 2019a).

At a city-level scenario, what does the transition toward a CE entail, and what can it do? In order to accomplish CE goals, it is imperative to overcome the "wicked problems" at a governance level, represented on the current environmental, social and economic challenges. Moreover, the traditional linear and experience-based approach governments have taken perpetuated such complexity over time. Thereby to understand the CE wickedness, it is required a deep comprehension of the system complexity and the ecology of its relationship. The established 2030 goals on decoupling economic growth from the use of resources recognise that "CE must be understood as a fundamental systemic [innovation] instead of a bit of twisting the status quo" (Kirchherr et al., 2017). From that perspective to best build a CE, is necessary a systemic approach that can generate interconnected solutions which enable a redesign of the current public policy conditions towards a more systemic and future-oriented governance model. This process enables change-makers/policymakers to have an overview of such complexity wich can reformulate those scenarios and create more resilient possibilities and connections (Rittel & Webber, 1973). This holistic and complex view enhances synergies between disciplines such as design, technology, economics, and sociology which are fundamental to harness approaches able to find innovative and anticipatory solutions towards sustainable development, urban transformation, economic restoration, and social cohesion (EMF, 2017). Such CE vision will generate a wide range of services fostering local resources and therefore, value creation.

These CE actions are traditionally approached from a product perspective, although they can be translated on an urban macro-level perspective (Ghisellini et al., 2015). On that view, the conceptual framework of a Circular City developed by Williams 2019a delivers an overview from which to comprehend the ways CE could demonstrate in an urban environment. Three main Circular Actions define this conceptualisation (looping, regenerating and adapting) and four supporting actions (optimisation, sharing, substitution and localisation). Specifically, this framework regards the looping actions of all resources (land, materials, water, infrastructure and energy), parallel to the ecological regeneration of the natural cycles (air, water, soil, biodiversity). Additionally, it features adaptation actions of infrastructure and communities, thus developing resilience.

Furthermore, it merges the ecological regeneration with looping resources actions, including adaptation actions to promote a systemic transition to a CE. This approach features the spectrum of strategies that at urban scale will be vital to reach an effective CE vision which generates a wide range of services fostering local resources. According to Williams (2019), such CE strategies are synthesised on the conceptualisation delivers an understanding of the

Figure 1.5 -post-Industrial precicnt Houston . Image by John Dunaway

principles and elements central to a Circular City model approach and exemplifies how these actions can operate in synchrony together effectively. Also, it turns into a vital tool to conceive a decoupling of resource consumption and waste of infrastructure in cities.

Based on the previous, the Circular City model enables such complex urban scenarios to trigger a new economic model that arises from the appraisal of the resources offered by cities or post-industrial precincts. Hence, fostering such an approach in post-industrial precincts should generate local economic opportunities, while regenerating the local ecosystem, decreasing the consumption of resources and waste. At the same time, provides sustainable livelihoods living environment for the local population.

On that perspective, for post-industrial cities to go towards a significant transition to a Circular City model, require new anticipatory approaches on governance from a holistic and systemic point of view that promote a cohesive and smooth transition to circular business models. This process implies active policymaking cooperation between the different stakeholders over networks which must be promoted and increased (Aquilani et al., 2016).

Therefore, the role of policymaker is crucial to deliver effective Circular City policies, primarily, because it should be aligned with the requirements of each context on relation to major adjustments in production and consumer behaviour. Secondly, because it must be synchronised with a bottom-up (NGO/entrepreneurial activity/social innovation) and top-down approaches (local government policymaking/ public-private partnerships)(Krauz, 2016; Pomponi & Moncaster, 2016; Ghisellini et al., 2015; Lieder & Rashid, 2016). Therefore the circular model policies should be based on an innovative model of governance open enough to new structures of rules and actors capable of combining top-down and bottom-up processes. Besides, to be able to colonise a circular future in our cities, a Circular City model must include a foresight overview with short and long term policy orientation that guarantees a cohesive and smooth transition to a circular business model in cities (EPSON, 2018).To activate new mechanisms of decision making, such as design thinking, participatory, and systemic approach towards codesign policies for a Circular City model.

AN OPPORTUNITY FOR THE DESIGNER TO ACTIVATE A PROCESS OF CHANGE

Traditionally the CE approach has been dominated by ecologists and economists have tended to dominate the debate, focusing on closed-loop industrial systems. Over the years, this trend has demonstrated that environmental quantification does not always reflect the equal trends in decision-making, perpetuating the mentioned above "wicked problems". Nevertheless, today cities are increasing their awareness as hotspots of CE, and considering that it is incredibly challenging for a city to establish which combinations of CE strategies can provide in the best environmental, social and economic performance. Therefore, it would be essential from the research to provide cities with methods and data that back their decision-making processes (Petit-Boix & Leipold, 2018).

With that in mind, it is required approaches to innovative strategies, services, and governance that can activate local resources while promoting social cohesion and flourishing local economies (Nevens et al., 2013). Moreover, the integration of various policy interventions, that will not imply "silver bullet" solutions (Simon Boas et al., 2015) or classical work frames of a single organisation (Frey, 2013), should be implemented. This policy-making process must require a mediator that encourages people to "think outside the box" and generate such disruption (Considine, 2012). In those circumstances, is where the role of design can be crucial, due to its nature to deal with complex scenarios (Celaschi et al., 2008). From a design point of view, it is possible to approach such scenarios with anticipatory approaches, such as design thinking, participatory and systemic perspectives (Buchanan, 1992).

Designers as mediators have the skillset to anticipate future situations and generate innovative outcomes promoting new approaches to complexity. For sure, such thought-process undertaken by the designer can be practical and useful applied to policy-making processes. The implementation of several design methods and thinking in the field of policy planning is evident in many practices of the last decade (Bason, 2014).

To arrive at that level of decision-maker, the designer has evolved its role, providing skills and capabilities for sustainable development and managing the complexity (De Los Rios & Charnley, 2017). Over the last decade, the design discipline has focused more on sustainability as a system of resilient relationships instead of a characteristic of individual components in systems (Ceschin & Gaziulusoy, 2019).

On that path, the Systemic Design (SD) discipline has emerged as crucial expertise which provides practical tools to approach complex scenarios with a holistic perspective. These tools call for the direct involvement of many stakeholders. Furthermore, it delivers a clear perspective of complex scenarios and highlights how to support active cooperation among local actors.
The SD strengths the involvement of all stakeholders involved in the policy-making process to generate effective decision-making for cohesive social-economical-environmental development in order to ensure also the success of the implementation stage. The systemic designer uses the traditional design skills, such as research methods, process thinking, sketching, and visualisation practice, with the implementation of new advanced skills, such as mapping schemes for the complex mediation between different knowledge, divergent thinking, co-design processes, critical thinking and creative making (Jones, 2014).

On that view, the designer can be an advocate to activate local initiatives, which empower communities to be directly involved in the problems they are affected by and spread complexity over the various nodes in the system instead of seeking a single, large, complex and unitary top-down solution (Green, 2013). From this perspective, the designer plays the role of an agent of change, co-creating services, strategies and systems that enable bottom-up social innovations to flourish, be sustained and scaled up through the synergy and support of top-down organisations.

Through a transdisciplinary approach, the SD invites actors from different sectors such as governments, civil society, and industry to co-create Circular City models undertaking bottom-up and top-down. From that perspective, it allows all local stakeholders to pull different economic activities that coexist to deliver social and economic welfare, which are the impacts of the CE fostering urban transitions. On the quest of flourishing resilience in cities, How can SD approaches for post-industrial precincts can foster a Circular City model to address the current environmental and economic challenges of society?

1.2 Research Problem

Even if there is an increasing acknowledgement of the systemic nature of global challenges, however, it is still a significant obstacle for the different governments worldwide to translate this complexity into a manageable common strategy to address present and future transitions (EEA, 2019). On the path to circularity, cities are in the amid of interconnected megatrends where their "wicked problems" reside. Consequently, if cities want to transition to a CE, they must tackle such wickedness. The interconnected nature of such critical drivers has a significant impact on how public policy for the CE operates. Such wicked scenarios are often promoted and reinforced by a linear model of governance, which encloses problems into "silos", and limits the understanding of the bigger picture (Head & Alford, 2015). Moreover, this bureaucratic model rejects external views on topics and policies which are often generated "behind closed doors", favouring a perceived sense of opaqueness from the outside and minimising people participation.

The trivial and interconnected phenomena that hamper a transition towards a Circular City can not be solved with the traditional linear and analytical method of problem-solving. Therefore, to achieve a transition of CE in cities, it is needed a radical shift in policymaking methods. For this reason, there is an urgent need to disrupt this governance silos and to shift towards a more adaptive and collaborative policy framework. Recent evidence suggests that considering a type of systemic assessment for cities which includes a view from the urban fabric, economic development, demography and culture, could radically influence the degree of implementation and foresight of CE strategies at the city scale (Petit-Boix & Leipold, 2018). This holistic overview could provide information about particular leverages and challenges that cities approach when transitioning to a CE. Especially the exploration of Circular City public policy leverages through anticipatory scenarios could bring more future-oriented and sustainable-oriented policy actions.

Nevertheless, system transitions in the governance for a Circular City model will disrupt the established investments, jobs, behaviours, knowledge and values. Consequently, the aim is to constraints city governments to impose policy instruments that enhance local value are consistent and cohesive with long-term environmental goals of a Circular City. On that long-term perspective, how to build value in governance? It is necessary to change the conception of "value creation", which is used and abused in our current economy, and which is mostly absent in the public sector (Mazzucato, 2018).On that view, the first condition to reach a CE transition is to build strong synergies and cooperation between the socio-economic components of the system. By providing a common understanding of complex problems and sharing responsibilities to cope with change, participatory approaches enable adaptive governance and resilient systems.

For an effective systemic assessment on complex relations in governance and their wickedness, is needed a systemic and interconnected solution (Brown T, 2011). On the last decade, Systems Thinking has provided practical approaches for raising social awareness about interconnected societal complex systems and Systemic Design has shown the means and knowledge to navigate this wicked scenarios aiming to maximise the value of government (Jones, 2018). Such approach involves design practices like participatory Design and co-design (Bødker & Grønbæck, 1991; Manzini & Rizzo, 2011) are born from this approach, and they all share a systemic perspective (Bødker, 1987). Also has influenced the Design for policymaking which has open the space for design practices to be involved in the construction of policies addressing designers' skills and knowledge towards higher goals like sustainable behaviours and development (Kimbell, 2015). These have been instrumental in the definition of a new role of Design inside complex social systems and set up the bases for social innovation as a space for design thinking and research (Jones, 2014).

On that view, a systemic transition into the Circular City to build local value requires a transdisciplinary approach that includes designers, governments, civil society, industry and academia to co-create CE strategies undertaking synergies bottom-up and top-down that fit the local context. The SD approach delivers an anticipatory instrument for territorial development, that delivers a new starting point for system mapping (Barbero, 2017). An overview of complex urban scenarios can trigger a circular economic model that arises from the appraisal of the resources offered by cities or post-industrial precincts.

There is the need to investigate in which ways a Systemic Design approach to CE policy can establish a more inclusive and cohesive policy design process for a circular model relationship with the context to develop local value. Therefore, this research explores how systemic design methods can aid the CE policy design process, particularly in the case of post-industrial precincts. Allowing to generate a Circular City model that is tailored to pull different CE activities that coexist to deliver social and economic welfare are activating new mechanisms to reactivate the value in these deprived areas.

1.3. Research Overview

In order to undertake the research problem defined earlier, this section describes the scope and direction of this research project.

1.3.1. Aim and Objectives

The overall aim of this research project was to examine how a Systemic Design approach can support a Policy Design process on Circular Economy for post-industrial precincts towards a Circular City model.To achieve this aim, the following objectives were set:

- To critically review literature on System Transitions, Design for Sustainability, Systemic Design, Co-design practices, Circular Economy Policy Design and identify a knowledge gap;

- To develop a theoretical proposition to co-design a Circular City model tailored to Post industrial areas;

- To undertake case studies aimed at developing Systemic Design approaches for Circular City model to co-designing situated circular strategies for decision-making;

- To assess the research's potential impact and contribution beyond the particular case studies.

1.3.2. Research Questions

To address the above-mentioned objectives, this project aimed at answering the following research questions:

1. *What Circular City model can be envisioned for post-industrial precincts, and what are the challenges and opportunities for their transition?*

2. *In what ways a systemic designer can co-design policies for a post-industrial precinct that encourage a transition towards Circular City model?*

3. *What value can Systemic Design approaches bring to the field of Public Policy on Circular Economy in cities beyond the scope of post-industrial areas?*

1.4. Research Scope and Direction

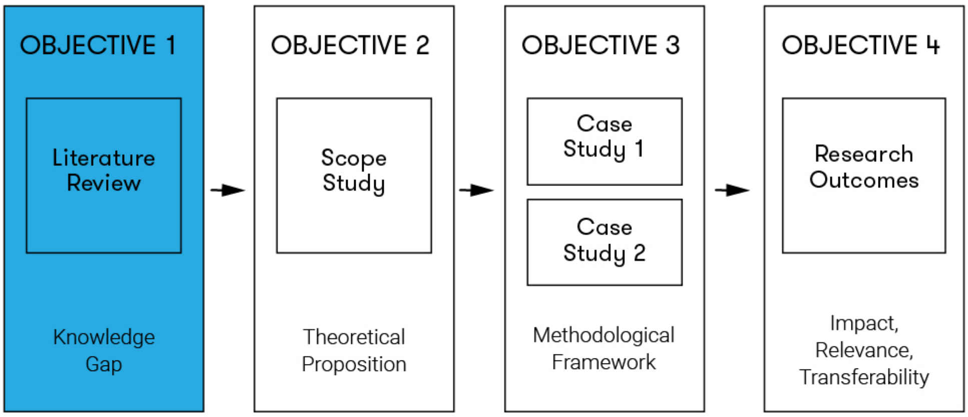
Given the aim and objectives set out above, the scope of this research lies within the field of Systemic Design. Such discipline merges human-centred design inside complex, multi-stakeholder systems which can highlight the potential opportunities for value creation, delivering new collaborative relations among the local actors and entities enhancing locally-based value chains, in order to obtain zero emissions (Bistagnino, 2011; Jones et al., 2018). From that view arises SD, which approaches and tackles problems on a systemic and complex level through the creation of strong and synergic linkages among all the stakeholders involved. In this case, systemic perspectives and participatory methodologies - which Systemic Design combines - can trigger innovative processes of sharing knowledge and experiences among different stakeholders and can build innovation in the public sector. Moreover, it opens the way to a more adaptive and co-creative innovation in policy-design processes by exploring new ways and tools provided by design, which enable broader and collaborative access to the public (Kimble, 2013). This co-creation process favours and reinforces the socio-economic systems connected, on a long-time policy perspective (Blomkamp,2018).

Nevertheless, we must acknowledge that SD is not yet "completely" inside the governance culture, and further investigation is required to understand the processes of activating meaningful decision-making towards sustainable development. With this in mind, this research emphasises the role of systemic design as a decision-making practice (Giraldo Nohra et al., 2020; Barbero, 2017).

This investigation approached the SD for a Circular City model through its application to post-industrial precincts, chosen as a unit of analysis for this decision-making case study research. Furthermore, it is essential to highlight that this research does not focus on policies themselves, but to explore the SD methodology for a governance "paradigm shift" towards a collaboratives approaches for value creation on Circular Cities. Also, this research does not try to formulate all the technical possibilities of a Circular City but to visualise how CE strategies can interact as a system.

Chapter 2

State of the art



In order to inform the course of the research and develop a conceptual framework to lead the following research stages, a literature review was undertaken. For this doctoral thesis, the topics examined in the literature are summarised in the following sections and mapped in (Figure 2.1).

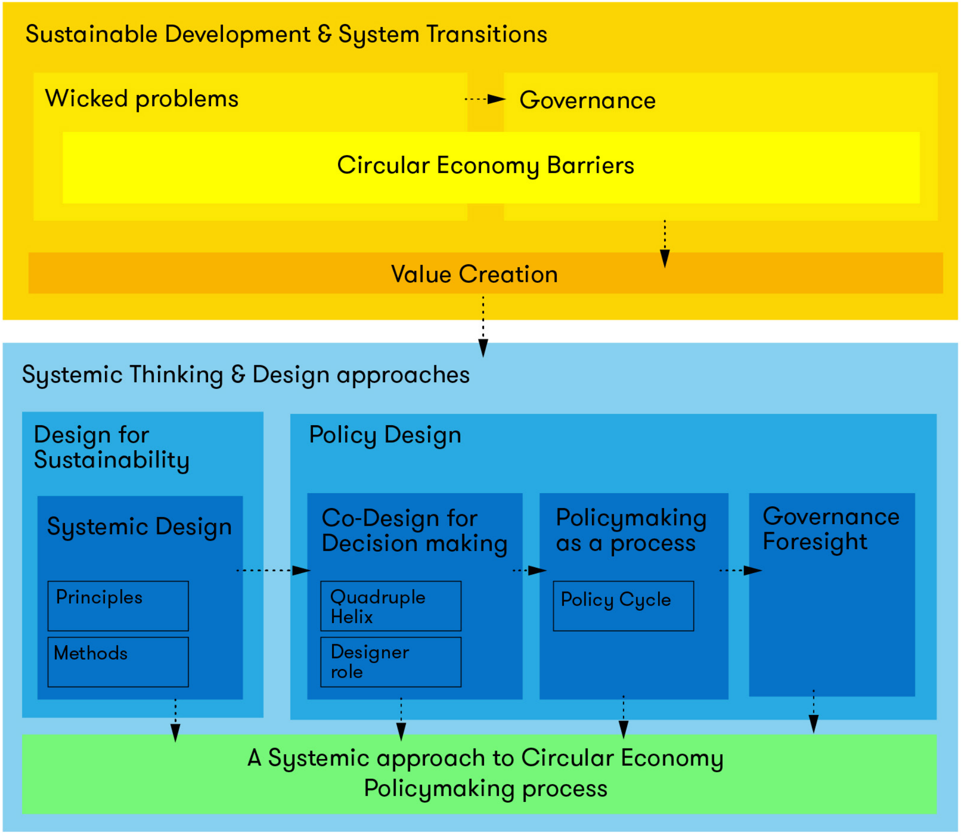


Figure 2.1 Literature review Map

2.1 Systems transitions and Sustainable Development

Today, cities are facing an acute crisis due to the increasing, and wicked global socio-ecological problems which have developed unprecedented complexities. Such a crisis has unveiled a long-run trend of disconnection amid economic growth, planetary boundaries a social integration in current cities (Cucca & Ranci, 2012). For instance, those systemic consequences are visible in the impacts of climate change. Research reveals that temperature rises to 1.5–2 C° compared to the pre-industrial cities stage (IPCC, 2018)(UN, 2017).

Other examinations that report the physical boundaries of today's city consumption is the "Planetary Boundaries" framework which is based on a scientific indication that the industrial revolution in cities has been the main driver of global environmental change. On that view, it presents a set of nine planetary boundaries within which humanity can continue to develop and thrive for generations to come. Nevertheless, the report presents that some of these boundaries have been overcome, exposing many cities to an accelerated risk (Rockström et al., 2009).

From that perspective, the first step towards sustainable livelihoods in cities comes from paradigm shifts: discoveries in physics—quantum theories—have permitted the transition from Cartesian and Newtonian mechanisms (a linear model) to a holistic and ecological view of life (Capra, 1988). Other scholars such as Kate Raworth has interpreted this phenomenon in economic terms as a change in the mentality of 21st-century economists. The framework defines a different economy embedded and based on a dynamic complexity, which is distributive and regenerative by design, created by adaptable social humans who have grown agnostic and stay inside the safe zone for humanity, which they consider the planetary boundaries that Raworth called the "doughnut" (Raworth, 2017).

The previous examinations acknowledge that today's socio-technical systems in order to meet society's needs require an extreme and transformative change (Ryan, 2013: Luthe, 2017). Such large transitions will entail a joint effort from all parties of the society from framing to implementing solutions. Still, these transformations demand governance processes that are challenging and overloaded of wicked problems.

Since the early 90s, the search for substantial transitions in sustainable development has defined a new agenda of research and practice, system innovations and sustainability transitions (Geels, 2005). In order to obtain such transformations, not only will require technological implementations but significant changes at governance and socio-cultural, that is to say, that it will be inevitably necessary systemic changes from a top-down and bottom-up perspective (Loorbach, 2010).

In contemporary cities, radical transitions necessitate design challenges that are innovative and political. Such changes require to re-design the current system dynamics that involve participatory processes to influence the collective and political nature of such systemic transitions (Gaziulusoy et al., 2017).On that perspective, this enduring crisis is building momentum to enhance the role of designers to develop new approaches and mindsets on sustainability transitions (Irwin & Kossoff, 2017).

2.1.1. A Wicked Problems World

On section 1.2 was introduced the problem scope of this research on the governance challenges affecting the transition towards a CE in cities, in the following section, it will be explored the origins and behaviours of such wickedness.

The last century, our extractive society model has brought irreversible impacts on ecosystems at every scale. Such problems are associated with climate change, pollution, epidemics, globalisation, unemployment, poverty and corruption. The interactions between them are classified as the so-called "wicked problems". These, defined by Rittle and Webber (1973), are represented by their complexity, uncertainty, interdependence, and highly interconnected social-ecological systems. Later on, Martin (2009) reframed the wicked problems identifying them in four dimensions:

First, causal relationships are unclear and dynamic. Suggesting that the causes and effects of wicked problems are complicated to identify as their complexity makes them ambiguous (Roberts, 2000). This uncertainty is considered political in a public sector context when the causes and effects of such wickedness are overseen. For instance, is the climate change a problem or just a manageable consequence of the quest for growth? (Bason, 2018). A current example of such a situation is post-industrial precincts mostly deprived as a consequence of globalisation: was the government more prepared on preventing them or into fixing the consequences?

Second, the problem does not fit into a known category. The wicked problems undertake interconnected and overlapping challenges and characterised by cutting nature over several policy fields and levels of governance. This cross-cutting nature means they are embedded in other problems like economic development or environmental preservation (Weber, 2008), increasing the levels of uncertainty (Van Bueren et al., 2003). This interpretation of the problem presents a significant limitation to the managing authorities as their notion of problem-solving is "evidence-based policy", which intends that those policy decisions are based on reliable information of "what works" (Bason, 2018).

Third, attempts at problem-solving change the problem. Such dimension is related to the linear approach on problem-solving and how the reactive nature of it has perpetuated the wicked problems over time. In the case of governance, this is reflected in the classic top-down dynamics where the inflexible system only allows "one-shots solutions" for potential ideas, plans, laws or initiatives. From that perspective, wicked problems require more iterative and nonlinear ways of addressing problems (Halse et al., 2010).

Fourth, there is no stopping rule. As wicked problems cannot ever truly be solved, there are no criteria to know if they have ever been addressed, meaning they imply a no "stopping rule" (Rowe, 1987; Ritchey, 2011). Such an argument comes from the assumption that every solution proposed can always be upgraded and improved in an iterative process.

On that view, How can we navigate such complexity to attain a sustainable and resilient future? What strategies must communities, governments, and industries address towards enabling resilient territories and ensuring the future of natural and social resources? Understanding the nature of the wicked problems can allow us to comprehend the nature of the current issues of the governments which address such problems linearly when approaching sustainable development (or Circular Economy).

2.1.2 Governance Wicked Problems on Circularity and Decision-making

The current system at the moment addresses into "solving" and "fixing" with reactive formulas and not considering that our complex problems are not something we can rationally analyse and 'solve' in predictable ways. The current practice of our governments to usually enclose problems into closed-off "silos", limits the understanding of the bigger picture (Head & Alford, 2015), by generating a clash among policy planners and policy implementers (Bason, 2014). Certainly, environmental challenges are a perfect example of wicked and complex problems: ambiguous and unstructured, overlapping in their impact on different domains, not entirely and forever solved so this require a continuous and iterative process of trying, learning and monitoring (Bason, 2018). On that perspective, to understand this silos nature is necessary to overview the two traditional governance approaches that have led to the current situation (Table 2.1). On the one side, the Top-down or hierarchical governance which intends policies to be planned and implemented by the government. In contrast, the bottom-up process which intends resource allocations through the action of market forces or community-based actions.

Surely, in exposing the complexity, uncertainty and no-linearity of wicked problems make it clear that transitions towards particular sustainability outcomes cannot merely be planned and implemented. That means the public sector needs to comprehend the nature of wicked problems to be able to generate systemic solutions towards long-term environmental and socio-economic goals in which Circular Economy (CE) is embedded. Moreover, to address increasingly globalised environmental challenges, active cooperation on a quadruple helix model (governments, industries, communities and research institutions) is needed. As seen in Table 2.1, this quadruple helix leads to the latest approach in governance, a combined top-down & bottom-up approach, which intends an intense synergy between all stakeholders.

	TOP-DOWN	BOTTOM-UP	TOP-DOWN & BOTTOM-UP
Community Role	Hierarchical, Command and Control relationships, with government responsible for steering markets and community.	Civil Society is considered to be autonomous and nearly independent.	Mutually dependent synergies among Policymakers, Industry, Research Institutions and Societal actors.
Government Role	Government sets targets decide solutions and shape implementation through policy and public expenditures.	Community and market actors are autonomous self-organise to choose solutions.	Government facilitate discussions among all stakeholders Industry, Community and Research Institutions aimed at defining problems and exploring solutions.
Scientific Disciplines Role	Political Science	Economics	Economics, Environmental, Sociology, Anthropology and Design
Policy Instruments	Formal policy, regulation and standards	Financial incentives (subsidies, taxes,).	System management, Sector-level Round tables, Public-private partnerships, Demonstration projects, Experiments, Strategic foresight and Public participation.

Table 2.1 Styles of Governance. Retrieved from Roberts and Geels, 2019.

Indeed, there is broad recognition in the current literature of the need of implementing the quadruple helix model as a critical approach to generate sustainable development and growth (Carayannis & Rakhmatullin 2014; Foray et al. 2012; Ivanova 2014; Miller et al. 2018). In particular, the quadruple helix model has proved to effectively support governance on promoting technical to social innovations and enhancing democracy in the decision-making processes. Moreover, the quadruple helix presents 'bottom-up' views from civil society that complement 'top-down' perspectives from university, industry and government in territorial development. Also, the participation of civil society promotes the generation of environmental-social innovations and validation for such transitions (Carayannis & Campbell 2009; Cavallini et al., 2016; Deakin et al., 2018).

Such perspective introduces two key concepts in this examination, closely linked one to each other: on the one hand, the shift from "government" to the broader concept of "governance" and on the second hand, the practice of co-design in policymaking. Firstly, with the term of "governance", is intended "the totality of interactions in which government, other public bodies, private sector and civil society participate (in one way or another), aimed at solving public challenges or creating public opportunities" (Meuleman, 2008). Consequently, this implies the shift in the role of government: from acting as a pilot with the knowledge and tools to steer society towards sustainability, to act as an enabler of society-wide transformation processes (Bason, 2018). Such an argument leads to the second concept of co-design. An appropriate definition of co-design methodology in policymaking delivered by Blomkamp E. (2018) who describes it as a design-led process, in which different kinds of people and knowledge cooperate in public problem-solving, guided by creative and participatory principles and tools.

It is a matter of fact that nowadays almost every government worldwide, especially in Europe, is facing the urgency to shift towards sustainability. The new born European Green Deal (which aims to make Europe the first carbon-neutral continent by 2050), as well as the New Circular Economy Action Plans (which focuses on the use of sustainable resources, especially for high-impact sectors) and the broader and global SDGs, they all witness the willing to cooperate for a more sustainable future.

Nevertheless, the clash between wicked problems and traditional problem solving, together

CHARACTERISTICS OF SUSTAINABILITY TRANSITIONS	GOVERNANCE IMPLICATIONS
Multidimensional Changes in Socio-technical Systems	Policy mix approach that goes across environmental, industrial, sectoral (mobility, energy, food, housing), tax and educational policies. This is important to achieve horizontal policy coordination.
Multi-actor Multi-scalar Process	Multilevel governance allows top-down guidance and funding as well as local policy experimentation. Such polycentric governance involves flexible and self-organising activities by non-state actors.
Mission Orientated Targets	Indicators about the governance direction (e.g. through financial incentives, regulation, targets) and more specific indications about innovation pathways (through roadmaps and foresight exercises).
Disruption and System Reconfiguration	Stimulate sustainable innovations but also engage incumbents and potential losers (via compensation or reorientation policies).
Promoting Transformative Innovation and Experimentation	Portfolio approaches, project-based learning and experimentation, especially with radical innovations (social, technical, business models)
Risks, Unintended Consequences and Adaptive Governance	Monitoring and adaptive governance, to ensure directional flexibility and address side-effects.
Urgency and Acceleration	More robust innovation and diffusion policies. Phase-out and innovation policies (through bans or stronger environmental regulations).

Table 2.2 Characteristics of sustainability transitions and their governance implications. Retrieved at European Environmental Agency report 2019.

with the shift from government to governance represents a significant reframing of the current sustainability challenges and response options. Even if it is acknowledged an urgency shift towards sustainability, however, implications for public policy and institutions are mostly unexplored.

As pointed out by the European Environmental Agency (EEA), the complexity of sustainability transitions opens the way to additional governance challenges, especially in terms of directionality, coordination and the management of unexpected consequences. Governments deliver the "Directionality" by defining visions, pathways and targets. Such action implies inevitably for an articulation of alternative futures and how to get there. Fundamental on that sense is specific normative choices, underlining the importance of public engagement and deliberation.

The different activities and the diversity of actors across sectors and scales of governance create the need for coordination. Public institutions have a crucial role to play in ensuring horizontal coherence across policy areas, as well as vertical coherence between local, national and international levels (Bason,2018). Finally, new emerging issues implies a need for both analytical approaches (e.g. horizon scanning) and adaptive governance approaches, grounded in monitoring and learning, that enable the timely reorientation of transition processes.

Nevertheless, today, despite the significant investments of resources in tackling our current major challenges among them the CE, it seems that most of them are just superficially solved (e.g. plastic pollution). While these problems continue to be a source of expenditure in the public policies agendas, new ones seem to emerge, increasing the environmental, social and economic pressure. On that perspective, the Table 2.2 presents the main governance themes and how they relate to the characteristics of sustainability transitions.

With that in mind, demonstrates again that wicked problems surrounding sustainable development cannot be addressed as institutions are used to - with a linear approach -, but it calls for a changing in directionality - in a more systemic way - intending a combined top-down & bottom-up approach.

In order to narrow the subject towards this doctoral research, it is essential to underline the wicked problems or main barriers to transition to a CE, in order to understand how the aspects that can hamper

Table 2.3 Main barriers to Circular Economy implementation

BARRIERS	DESCRIPTION OF BARRIERS
Cultural	Current value and norms, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
Economic	Economic viability, Prospective resource value is uncertainty, Need of financial incentive, Financial risk, Global supply chain, Cost of dealing with pollution, High land value and isolation of low-value activities, Restricted demand for looped sources, Health and safety risks, Low price of raw material, Absence of public expenditure and dependence on private expense.
Information	Deficiency data availability, Lack quality of data, Deficiency of information, Loss of trust in information transfer and collect.
Regulatory	Absence of supportive framework, Emerging models for looped resources, Need of multilevel regulatory framework.
Political	Neoliberalism, Require for long-term political support, clashing priorities, Absence of combined approach to policy-making.
Institutional	Fragmented government, Cultural and structural inertia, Absence of cross-sector alliance, Separate performance of services, Private actor appointment, Absence of institutional capability, Managing authorities with limited controls/capabilities/resources, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers.
Technological	Absence of dissemination on circular planning and design methods, Technical limitations, Absence of operational conditions, Modelling resource flows, Current linear resource flows
Environmental	Pollution of environment, Long-period to renew ecosystems, Depraved urban resources.

CE policymaking process. Different sources have highlighted the wide range of the obstacles the CE has (Kirchherr et al., 2018; Dieckmann et al., 2020; Ritzen et al., 2017; De Jesus et al., 2018; Hart et al., 2019). However, Williams (2019b) and D.A. Vermunt (2019) deliver a more holistic perspective of the problematics that a transition to a CE will imply. In their analysis, both examine how context influences the difficulties of implementation. Mainly, they go beyond the technical aspects, but they argue more profoundly about the cultural and societal aspects challenges and how these alter with context. On that view, this examination combined the vision of CE barriers from both authors in the following Table 2.3.

2.1.3 Value Creation tackling Wicked Problems

So, how to address the circularity wickedness within a governance system? As seen in Table 2.3, the current scenario wickedness comes from the lack of value creation. On that view, value intends the wealth creation or the benefits that society obtains from the system -and vice versa. For example, on the provisioning services (e.g., food), education institutions, health and social care services, housing, social security, infrastructures, energy, water and waste system, regulating services (e.g., flood control) and cultural services (e.g., recreation)(Cole & Parston, 2006). These categories of the public value are a way of measuring countries' progress towards the achievement of societal goals -such as the SDGs- similar to the CE targets introduced in Chapter 1. With that in mind, innovation in public policy actively shapes and co-creates services that drive more sustainable and inclusive forms of welfare and growth in our current system (Jacobs et al., 2016).

On that perspective, the purposed quadruple helix (Table 2.1) intends the co-creation as a collaborative design process among public sectors, private sectors, research institutions and civil society. In this scenario of collective policy design, all the actors involved, including citizens, are all intended as equal partners in design and delivery, and people are assets and not just subjects of policies (Sanders & Stappers, 2008; Gillinson et al., 2010). Still, this type of model faces several barriers:

- *the current reactive policy-making* which is more focused on fixing the market failures and re-distributing wealth among other value-extraction activities (Mazzucato, 2016);
- *a siloed-shaped public bureaucracy* which rejects external views on topics and policies, minimizing people participation;
- *a lack of consciousness by public servants*, who are not aware of new approaches to policy innovation (Bason, 2018);
- *lack of tools and platform* to conduct co-creation in practice (workshop, toolboxes, innovation labs).

Nevertheless, it is crucial to underline that input from a diverse group of stakeholders is needed to effectively incorporate both social and ecological dynamics in environmental decision-making processes (Irvin & Stansbury, 2004; Reed, 2008). Indeed, by confronting their different sets of values and world-views, a much broader scenario is analysed from the beginning. More specifically, including a quadruple helix can contribute to:

- *a more profound knowledge on different scales*, which has a central role in order to support adaptive governance and ecosystem-based management programs (Gadgil et al., 2003);
- *assure higher quality and an endurable decision making towards environmental challenges* (Millennium Ecosystem Assessment, 2005);
- *make the implementation processes smoother,* saving time and money on political wrangling (Pahl-Wostl & Hare, 2004).

Besides the benefits brought from a diverse stakeholder engagement, participatory and co-creative approaches reinforce other social aspects necessary to address CE wicked problems (Table 2.3):

- the enhancement of social learning and capacity building;
- the increase of transparency by building trust;
- the mediation of power through cross-sector collaboration.

By providing a common understanding of complex problems and sharing responsibilities to cope with change, participatory approaches enable the first conditions to build adaptive CE governance and resilient systems.

2.2 Systems Thinking and Design approaches

Currently, sustainability is understood as a system of resilient relationships rather than a characteristic of individual components of systems (Ceschin & Gaziulusoy, 2019). As the world has become more interconnected, a desirable sustainable future has increased in complexity. This complexity is only visible through ‘wicked problems’. These challenges are portrayed as trivial or lasting situations that cannot be overcome immediately due to their inner complexity or exogenous/endogenous relations (Jones & Kijima, 2018).

The approaches towards complexity and its wickedness are based on the statement that *“Systemic and inter-connected problems need systemic and inter-connected solutions”* (Brown & Wyatt, 2010). In the last half-century, the System Theory and the Systemic Thinking approaches have been integrated into design discipline. The relevant thinkers on Systemic Thinking, collected by Ramage and Shipp in 2009, agreed that *“To make sense of the complexity of the world, we need to look at it regarding wholes and relationships rather than splitting it down into its parts and looking at each in isolation”*. According to Capra (2014), Systemic Thinking emerged between the 1920s and 1930s, due to contributions of diverse disciplines as psychologists, biologists, and ecologists. However, researchers have agreed that the starting point of the Systemic Thinking movement was in the 1940s, with the appearance of the two schools of thoughts, the General Systems Theory (Von Bertalanffy, 1969) and Cybernetics (Wiener, 1948). Thanks to discoveries in physics—quantum theory—there was a shift in the cultural paradigm of western culture from Cartesian and Newtonian mechanisms to a more holistic and ecological view of life (Capra,1988). Fostering the appearance of approaches that will foster those holistic views such as; systems methodology (Checkland & Poulter, 2006), critical systems thinking (Ulrich, 1983), visual Thinking (Arnheim, 1969), social systems design (Banathy, 1996) and autopoietic systems (Maturana, 1975).

The holism theory, which suggests that the whole is more than the sum of its single parts, has determined the properties of systems that have completely changed the way we see complexity. Thinking in systems means looking at the whole, analysing single components and focusing attention on relationships and connections. The system interdependence among each part of it and between the system and its environment, defines the system’s boundaries, thus creating an identity and not in isolation. Systemic Thinking, in practical terms, means zooming out from a single part and considering that part’s relationship to its surroundings and other ecosystems (applying a qualitative approach more than quantitative approach) and mapping the situation more than measuring it, by using a multidisciplinary approach (Capra, 2014).

Application of knowledge on living systems to other systems created by human beings enables us to learn from nature and subsequently create something that will be sustainable itself. The current complex scenario can only be approached through a process-based, multi-scale, and systemic approach (Bagheri & Hjorth, 2007). Such a shift involves a radical transformation in how human society operates and requires profound leverage for change from social, cultural, institutional, and organisational perspectives (Geels et al., 2015: Loorbach, 2010). As suggested by Jones (2014), *“Systems theory and its guidelines in practice—Systems Thinking—have been promoted as the best techniques for raising social and environmental awareness about interconnected complex systems, which might determine human destiny”*.Researchers have agreed that the concept of interconnections represents a primary ability to tackle current complex scenarios and the immediacy of a sustainable future, which involves a complete social, economic, and environmental perspective (Battistoni et al., 2019).

Consequently, sustainable development wicked problems require the participation of experts from diverse background disciplines to achieve innovative complex solutions. To facilitate such dialogues among technicians, economists, humanists, and many more, the designer acquires a key role, which is underlined by his/her competences and high skills as a “*mediator*” (Celaschi, 2008, 2013). For his/her capability as an expert in designing future scenarios (Weigand et al., 2014), a transition in design discipline also takes place—from the limited perspective of product designer for the industry to a designer of complex systems collaborating with many other experts (Veneziano et al., 2018).

2.2.1 Design for sustainability towards systems

On the last decades, the Design field has trespassed its frontiers making its domain broader and less tangible than ever. Traditionally, the discipline has been linked to the creation of objects, starting from the mid-late of the 20th-century it has enlarged its application to services and systems (Ceschin & Gaziulusoy, 2019). Parallel to this, the Design field has embraced the different aspects of the sustainability dialogue and practice as a primary engine for innovation in our society on the industry, local communities, and government (Design Council, 2018; Gruber et al., 2015).

Recently, an increasing amount of designers are applying their skills and methods to go beyond a tangible outcome, towards intangible goals like sustainable behaviours and development. One of the reasons for this change is the increasing recognition of designers' impact. In fact, in the last fifty years, designers have been accused of the globalisation effects on mass production and uncontrollable consumption. In reaction to these phenomena, the design community acknowledges being a "dangerous breed", as described by Victor Papanek (1971) in his book "Design for the real world". Movements around design for sustainability have gained momentum, providing a different vision on the role of the designer.

Therefore, the shift towards dematerialisation is the tipping point for design as the beginning of an evolving process towards services and systems. At the same time, it shifted the designers' attention from the single user to the communities as users, becoming a more participatory discipline while expressing its social and democratic nature (Buchannan, 1992).

The recent review presented by Ceschin and Gaziulusoy (2019) describes the evolution of the design for sustainability: from product innovation to product-service system innovation to spatial–social innovation and socio-technical system innovation. This timeframe illustrates how design has evolved towards dematerialisation and is approaching nearer to solutions for complex social, environmental, and even political problems, as suggested by Papanek (1972). Such transition through design towards a sustainable future requires a profound comprehension of how to design innovative transition strategies inside complex socio-technical systems. On that view, Irwin (2011, 2015) illustrates a spectrum of design approaches such as:

- *Service Design:* A discipline that comprehends human and social practices, co-designing new synergies and experiences triggering transformation processes (Holmid & Evenson, 2008; Meroni & Sangiorgi, 2011). Service design outcomes render profit and benefits for the service provider and useful services for the user.

- *Design for social innovation:* A discipline that reaches social demands more effectively than existing solutions, within a 'co-design' method in which designers work as facilitators and catalysts. The outcomes present rising socio-technical and alternative economic models, leading to meaningful positive social development.

- *Transition Design:* A discipline that aims to reach a societal transition proposing new socio-economic and political paradigms towards a positive social and environmental change.

During this transition, designers have expanded their field of action from a single user to communities as users, thereby becoming a more participatory discipline and delivering sustainable services and systems. This last part is synthesised by Buchanan (1992), who has addressed the role of design practices to approach current wicked problems to transition towards a more resilient, fair, and sustainable society.

Hence, more and more developments around design for sustainability have gained momentum, providing a different vision for the role of the design discipline. A visible manifestation of this vision is the manifesto of Danish designers, 'Design for People, Profit, and Planet', which proclaims the designer's future role by balancing three interests for innovation and sustainable development and moving forward a concept considered contradictory in the past (Valade-Amaland, 2011). Consequently, the designer has changed its role, providing skills and capabilities for sustainability development (De Los Rios & Charnley, 2017).

Designers have been hailed by the current complexities as the ones with creative abilities and other skills to approach future scenarios and face current wicked problems. The designer's approach to problem-solving refers to the designer's ability to create frames. Such a result comes from dealing continuously with complex problems that have to encourage designers to create these frames (Dorst, 2011). The abductive reasoning method for creating new frames allows a more comprehensible interpretation of complex situations in terms of themes, which are based on a process of analysis related to phenomenological methods (Van Manen, 1990; Luthe, 2017). The primary outcome of this process will be solutions focusing on strategies. Tools like graphic visualisation design expose all the components of complex scenarios, displaying different levels of interconnection that increase the number of interpretations for a context. Designers in this process seek to deliver a broader range of possibilities to generate other types of conversations on innovative approaches and problem-solving. Involving the audience on a deeper level and changing their traditional roles as passive recipients into active participants that reach design conclusions allows the comprehension of innovative approaches by a wider audience where arguments can be seen from a more significant spectrum of perspectives (Buchanan, 1992).

2.3 Systemic Design a paradigm towards resilient scenarios

The result of the application of Systemic Thinking to the design discipline is the birth of a new discipline called Systemic Design (SD) which addresses wicked problems in complex socio-technical systems within a holistic approach applied to projects for artefacts and services. More than a new discipline, SD is an innovative system-oriented design method to undertake complex phenomena in the current systems. One of the most adopted definition is provided by Jones (2014):

"Systemic design is distinguished from service or experience design in terms of scale, social complexity and integration. Systemic design is concerned with higher-order systems that encompass multiple subsystems. By integrating systems thinking and its methods, the systemic design brings human-centred design to complex, multi-stakeholder service systems as those found in industrial networks, transportation, medicine and healthcare. It adapts from known design competencies - form and process reasoning, social and generative research methods, and sketching and visualisation practices - to describe, map, propose and reconfigure complex services and systems."

As Jones (2018) declared, the origin of this application passed from a soft part represented by the Social System Theory to the hard part, represented by Systems Dynamics: "Christopher Alexander, Victor Papanek (with critical social design), and John Chris Jones (design methods originator) influenced a new generation of designers". One of the many reasons for this application is the need to develop more innovative solutions as a response to the complexity of design problems, as Charnley (2011) has stated. Other scholars such as Bhamra, Hernandez, and Mawle (2013) also recognised this relationship: a higher level of design for sustainability is reached through innovation at a systems-level—a more radical and strategic approach that involves many stakeholders, such as communities, governments, companies, and customers.

On that perspective, the SD has emerged as an approach to provide systemic and interconnected solutions to the complexity of the current situation, encompassing economic, environmental and social contexts. Furthermore, Jones (2014) outlined this evolution process in four contemporary domains of design, which have increasing complexity:

- *Artefacts and communications:* that is the traditional way of conceiving the design practice, as a way of producing artefacts
- *Products and services:* this stage includes the services for value creation (i.e. service design, product innovation and user experience)

- *Organisational transformation:* design as a change-oriented practice, using complex and bounded strategies for business transformation
- *Social transformation:* design as a change-oriented practice, for complex social systems, policy-making and community design

A systemic designer embodies traditional design competencies—form and process reasoning, social and generative research methods, and sketching and visualisation practices—being, moreover, able to *"describe, map, propose and reconfigure complex services and systems (they view design as) an advanced practice of rigorous research and form-giving methods, practices of critical reasoning and creative making, and sub-disciplines and deep skillsets"* (Jones, 2014). Furthermore, the SD can focus on different scales as they can visualise problems, think about new strategies and eventually "materialise" their ideas. According to Bicocca and Barbero (2017), it must be acknowledged to designers the ability to:

- *make information accessible* and straightforward, by managing a large quantity of data and making them accessible to an end-user through easy-reading maps, schemas and scenarios (i.e. IDEO cards, giga-maps...);
- *think creatively*, and if applied to policy-making, it can bring innovative solutions;
- *create connections in complex systems*, to offer a broader look at the problems and to boost transdisciplinarity. The systemic designer can interconnect the elements of a system, in order to generate new business activities, products and relations.

Today, SD has worldwide relevance on international research networks, such as the Systemic Design Research Network (SDRN), have approached the topic since 2012, now known as the Systemic Design Association (SDA) created in 2018 features the involvement of the Oslo School of Architecture and Design, Ontario College of Art and Design University, Politecnico di Torino, National Institute of Design in India and many others.

To have a better comprehension of the Systemic Design research state of the art, Table 2,4 displays the most relevant research groups with their methodologies and areas of study. Furthermore, every institution develops a substantially different approach to systems and sustainable development at different levels from; products, services, and sustainable local systems. At the same time, they cover a broad spectrum of sectors such as; healthcare, governance, agriculture, craftsmanship, technology, architecture and others.

The aim of Table 2.4 is to deliver a panorama of the exciting research streams of the Systemic Design in order to have a better understanding of the approach chosen by this research investigation based on the Systemic Design approach developed by the Politecnico di Torino. Unlike the research groups presented in Table 2.4, this approach was chosen for this doctoral research as it had previous experiences on systemic approaches for circular economy policymaking, topics that are central for this examination. Even though this research recognizes that the SOD approach presented by AHO has done remarkable work on the systemic approach on the built environment and the OCAD University has executed work on policymaking process for the health sector, the Politecnico di Torino approach offers more experience and a methodology that is more accurate for this investigation. On the following section, this explained into detail.

SYSTEMIC DESIGN AT POLITECNICO DI TORINO

In the early 2000 s, a research group at the Department of Architecture and Design in Politecnico di Torino (Italy) (with the ZERI Foundation) developed a particular SD approach as a step forward for eco-design to reach a blue economy and CE. This group wanted to model production and energy systems after nature's principles, primarily connecting their outputs and inputs to reach zero emissions in the air, water, and soil (Figure 2.2). Barbero (2012) has defined the methodology *"looks at making better use of material and energy flows in order to model our production and energy systems after nature. Material and energy loops are open in order to decrease environmental impacts and resource depletion."* Bistagnino (2011) presents the SD's primary goal is to promote a paradigm shift, thereby providing a new way to act with:

Table 2.4 Systemic Design relevant research groups

SCHOOL	THEORETICAL APPROACH	PROJECT FIELDS
System Design *OCAD University Toronto, Canada*	The Strategic Innovation Lab at OCAD University defines SD as a research-based practice which applies systems theories into sociotechnical systems addressing complex policy, organisational or product-service environments. This SD approach is considered a design practice to address wicked problems, and most environmental challenges regarded as indeterminate complex, implemented to multi-stakeholders and multi-environment systems, from the healthcare, policy and business sectors. Their methodological approach is presented by Jones (2014) in principles: -Idealisation: idealised future scenarios are recognised to foster design actions -Appreciating complexity: the complexity of wicked problems is linked to the social perception of it; consequently, design intentions will be to simplify complexity. -Purpose finding: systems can be arranged by agreement and designed. -Boundary framing: problem framing serves to establish a suitable design approach concerning its environment. -Requisite variety: a complex system must be capable of adapting to the environmental influences of the system. -Feedback coordination: feedback control is incorporated into the system design process. -System ordering: designers arrange all components of the system is a valuable way to facilitate the visualisation and awareness of complex scenarios. -Generative emergence: design needs to examine the impacts of the distress of system relations on the environment to anticipate a created emergence. -Continuous adaptation: design should consolidate cyclic feedback into the sociotechnical system to improve its resilience. -Self-organising: design strategies must enhance awareness and promote organising behaviours.	Projects focused on healthcare policy, business sectors and educational services to improve social impact .
Systems Oriented Design *Oslo School of Architecture and Design Oslo, Norway*	Systems Orientated Design (SOD) combines design examination and practices with the pluralistic family of systems thinking and, therefore, can bring together multiple disciplines and domains. The SOD also is associated as principles that can encourage designers to shift into systemic, relational, dynamic, holistic, and consequential strategies. The design method concentrates on the data analysis and the visualisation of the complex relations among the stakeholders, to enlarging comprehension of the system. SOD introduces systems thinking as a functional design skill, presenting designers innovative instruments like the GIGA-mapping , to cope with the current complexity needs. Sevaldson (2011, 2018) summarised the methodological approach of AHO in eight systemic design principles: -Act proactively spatially with complexity. Utilise visual aids to be able to cope with complexity throughout the design process. -Co-design the co-understanding of the system by sense-sharing across multiple perspectives. Create a common understanding of the context complexity. -Emphasise relationships over nodes. Perceive system components as a large knitted field of systemic relationships. -Toggle across time and space. To fully comprehend the relationships that exist across units of analysis. -Interconnect problem areas. To avoid simplifying complex problems into simpler components. -Leverage a range of actionable systemic interventions. Distinguish various solutions correlated and execute systems thinking actionable, not only theoretical. -Perceive the shapes of the emerging holistic system. Define the overall character of the system and produce a shared recognition of its holistic form. -Evaluate possible systemic consequences. Examine the potential consequences of systemic interventions	Projects around sustainable built environments, introducing a systemic approach to architectural design including local ecosystems, environment and the spatial–material organisation of architecture.
Systems Thinking in Design *National Institute of Design India*	The SD approach of the National Institute of Design (NID) India is based on the research of Ranjan (2013), which incorporates Systems Thinking as the last level of design, also called Strategic Design. This approach underlines that SD must to investigate system components effects on a complex set of user-related parameters and the environment, throughout its life cycle. The NID approach concentrates on recognizing the system interrelationships to address complex issues at social, cultural, economic, and environmental levels (Nahar, 2013). On that view, the visualization methods are fundamental to the understanding of the system and the outcoming challenges and strengths.	Projects focus on the improvement of natural resources and local artisan skills such as the NID Centre for Bamboo Initiatives public, backing inclusive innovation..

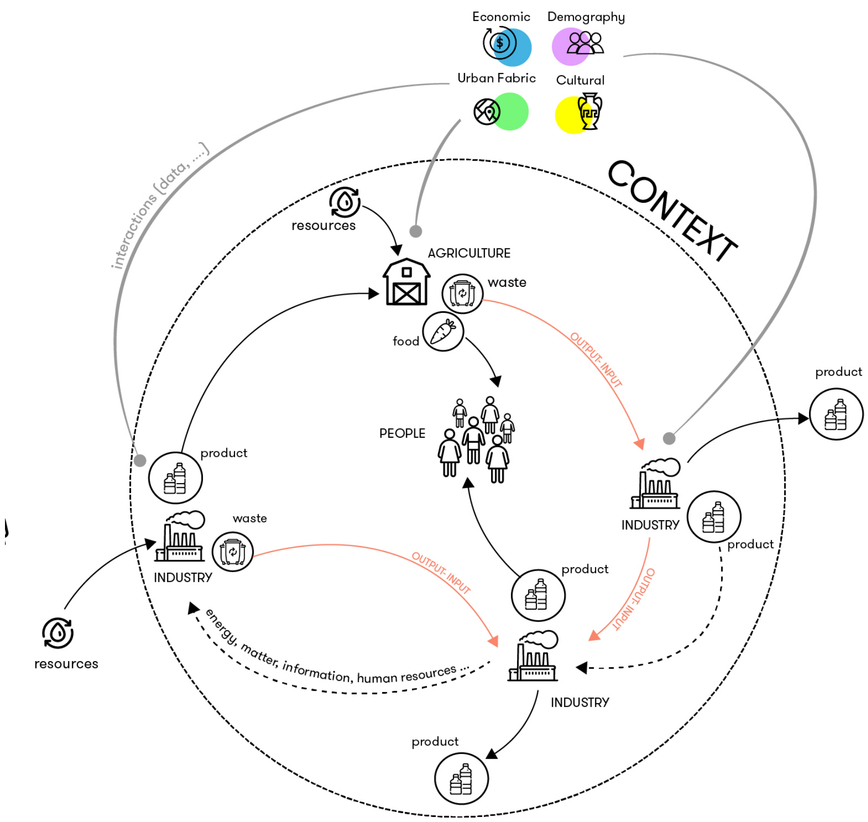


Figure 2.2 A graphic visualisation of the material flows in the Systemic Design approach at Politecnico di Torino. Retrieved from Battistoni, et al., 2019

1. A change in the management of resources, improving production processes through a continuous transformation of matter;

2. To activate new relationships between subjects, producing a general wellness improvement in people.

This approach to SD confirms the central role of users, but it sets out the interwoven relationships within the system as the starting point of the design process, through a "Holistic Diagnosis" that highlights criticalities and potentialities of the system. Social, economic, and environmental impacts are assessed to guide the design process towards innovative solutions that enhance the sustainability and resilience of the system, empowering the role of people within it. This SD approach is developed around five guidelines by Bistagnino (2011):

1. *Outputs become inputs:* in the socio-technical systems, the waste (output) of a system becomes a resource (input) for the development of another one, providing rise to a CE.

2. *The relationships create the system*: System Components are strongly related within material and immaterial flows that create the system itself. The design process converges on these relationships, reviewing them to determine new sustainable strategies of production and consumption.

3. *Autopoiesis:* Nature living systems regenerate and maintain themselves by self-organising the production of their parts. In socio-technical systems, autopoiesis involves the capacity to efficiently and sustainably, distribute material and immaterial flows.

4. *Act locally:* living systems are correlated to their environments; on that view socio-technical system should be rooted in its environment, by employing human, environmental and cultural local resources, to support local development.

5. *Human at the centre of the project:* A human being is considered connected to its environmental, social, cultural, and ethical context, and its needs become central in design requirements,

Figure 2.3 Systemic Design Methodological Steps

1 Holistic Diagnosis

This examination aims to deliver a comprehensive system perspective of the scenario, from the quantitative to the qualitative perspective with field and desk research. An analysis and visualization of all the components that define the current scenario this the total amount of resources, material flow and stakeholders the system implies.

2 Definition of problems & leverages for change

This step implies the visualization of the complex data collected in HD; it is possible to underline the challenges and opportunities to gather leverages for value creation and eco-guidelines, for the definition of new complex systems tailored to the territory.

3 Design of a System

A new system is designed. The goal is to obtain zero emissions. System is created based on relationships between processes and actors, optimising the energy and material flows and valorising the waste as a resource.

4 Outcomes Evaluation

An assessment of the environmental, economic and social benefits, implies a foresight vision.

5 Implementation

Apply the proposed system in the given context; this implies the implementation of short and long term strategies. The purpose of this is a gradual transition that should create local value and deliver more realistic and feasible new economic, environmental and participatory activities.

6 Results analysis & feedback

The assessment of the implemented system and ensuring autopoietic is the ultimate proof to know a territory has transitioned.

by promoting their active participation toward community empowerment. The design process recognises the social, cultural, ethical and biological values that all users share.

The SD methodology passes from the definition of the context to the design of a complex system. According to Barbero (2012), this approach to design production processes has several positive outcomes :

- *Environmental:* A lower consumption of local resources and the use of more sustainable production processes;
- *Social:* The creation of new jobs linked to the cultural and spatial places of belonging;
- *Economic:* The optimisation of resources minimises costs and increases the competitiveness of companies, as well as new business areas.

Although SD has been applied to different socio-technological sectors, its implementation in the development of sustainable territorial systems enabled the creation of specific tools aimed at holistic analysis and design. This SD approach supports active cooperation between local stakeholders that results in new, locally-based, value chains (Barbero, 2012). In this perspective, it has created a synergic link between the productive and natural context of the given territory, at the same time reinforcing the socioeconomic systems connected to that territory, within a long-term vision (Giraldo Nohra et al., 2020).

From this perspective, the SD acknowledges contexts to be understood in a deeper and broader perspective, surpassing the challenge of the small scale through a holistic approach. This overview considers in parallel the small and large scale into specific leverage for change while taking into consideration the bigger picture. The SD within a territory aims the generation of new relations among the components enabling the visualisation of the hidden potentialities: as a result, SD boosts a proactive collaboration among local actors and enhance future production activities (Bistgnino, 2011). Such outcomes lead to a better comprehension of the capabilities of the discipline to foster new sustainable and resilient economic models. The SD methodological approach is based on six main steps (Batisttoni et al., 2019) see Figure 2.3.

Systemic designers approach this process by gathering qualitative and quantitative data to be able to map the context within a multidisciplinary perspective (Barbero, 2017). Thereby they utilise graphic visualisation tools to display the interconnections of the scenario components, rising number of interpretations for that context (Svedalson, 2011). The aim is to generate a broader range of probabilities to create innovative solutions and problem-solving. From this perspective, designers can address various scales to visualise challenges and conceive new strategies.

In this scenario, it is clear the role of designers as mediators since they enable facilitating and mediating different competencies. The active role of a designer in the process of policy-making unlocks a capacity of organisational versatility and anticipation. In this view, human centeredness is the main component that design includes the process. Hence, designers also underline the importance of the aforementioned qualitative features like culture, uses, or local resources (Battistoni et al., 2019).

This methodology has gained relevance in multiple environments, especially in academia. It has been used in the Masters of Science program in ‘Systemic design ‘Aurelio Peccei” since 2003–04 (before it was named ‘Ecodesign’) at the Design School of the Politecnico di Torino. It is also used in European projects (e.g., RETRACE Interreg Europe project, DigiCirc H2020 and ProGIreg H2020 project) and collaborative studies with industries (e.g., Agrindustria Tecco s.r.l., Luigi Lavazza S.p.A., and Groupe Poult).

THE HOLISTIC DIAGNOSIS

To be able to determine sustainable solutions for complex scenarios, Systemic Design expertise provides a method to tap into a holistic perspective of these contexts. The Holistic Diagnosis (HD) profound examination provides to the SD an opportunity to create autopoietic open systems based on contextual assets. Due to the importance of this tool as an innovative context framework to obtain a holistic picture of the state-of-the-art and to determine advantages for change, this article defines and assesses a structured process to execute HD, taking as its background a deep understanding of the

Design Thinking and Systems Thinking concepts, which frame the process to define it. (Barbero, 2017) This disruptive approach improves Design methodologies in the first phase of problem definition and research, making the HD a relevant tool for designers to address problems and framing complex scenarios within an innovative and transdisciplinary approach, thereby promoting a horizontal dialogue among all connected components. Ultimately, fostering synergies between disciplines like design, technology, economics, and sociology, which are fundamental for finding innovative and anticipatory solutions for holistic and complex changes (Battistoni et al., 2019)

From the perspective of the SD discipline in Politecnico di Torino, HD exists in the first stage of the design path. It is a method for comprehending the problem definition, which, in the design process, is a common step. As Buchanan (1992) stated: "design process is divided into two distinct phases: problem definition and problem solution. Problem definition is an analytic sequence in which the designer determines all of the elements of the problem and specifies all of the requirements that a successful design solution must have".

The term HD comes from the union between diagnosis—the central concept—and holism—its characterisation. 'Diagnosis', according to the Cambridge dictionary, refers to the doctor's opinion and, therefore, belongs to the healthcare field. In Italian, diagnosis is translated as 'rilievo', which refers more to a survey in architecture (site survey, architectural survey, survey maps, map making, field survey, and metric survey). Furthermore, the current literature demonstrates that holistic approaches have started to be used in other different contexts, from engineering to management and governance, the term is emerging in the field of participatory design applied to agroecology, which could reflect the development of holistic approaches in the design field related to sustainability (Battistoni et al., 2019).

According to Bistagnino (2017), the HD methodological frame is defined as a mapping state-of-the-art useful for giving indications about the quality and the quantity of what an anthropic process involves. The aim is to highlight the ongoing relationships, both inside the system and between the system and its environment (local context). As a result, it can analyse the implications at the territorial dimension, from regional to worldwide ones.

With that in mind, the HD represents a useful tool to guide the first complete overview analysis of contexts/ products/processes/services and define the current state-of-the-art. From this point of view, HD is related to Systems Thinking, which defines a detailed study of behavioural patterns and interactions. An analysis of this nature is a holistic overview of the system assets and how their interconnections/ relations result in the sum of all parts/subjects that interact between the environment and other systems (Battistoni et al., 2019).

To reach a practical understanding of the HD results, we require visualisation tools whose main aim is to break down the information of the system. The research synthesis is represented on a graphical outcome (giga-map) that displays all the components of the system and the relationships between them (Sevaldson, 2018; Davidová, 2016).

As this research examination will apply the SD and HD tool as it's a principal research methodology in Chapter 3, it will present more in detail the steps and assessment tools.

2.3.1 Systemic Design featuring Co-design approaches

So how Systemic Design can co-creates a circular system? As seen in as approached in section 2.1.3 to overcome the wicked problems and achieve circularity is imperative a territorial value creation approach which intends the wealth creation or the benefits that society obtains from the system - and vice versa. To achieve this is necessary to co-design innovation in public policy through a quadruple helix to foster a transition towards circular systems that drive more inclusive forms of welfare and growth (Jacobs et al., 2016).

According to Sanders & Stappers (2008), co-design is recognised as a mindset for a creative participatory practice where stakeholders are acknowledged as experts of their own experience and provide their ideas during a design process. Also, the designer is not only a mediator but an active participant on a collaborative process with multiple stakeholders (Mattelmäki & Sleeswijk, 2011). Such an approach has recently spread the adoption of design practices into public bodies (Villari, 2012).

On that scenario, co-design has been considered a process method for design systems facilitating stakeholders encounters to support collaborative planning, social change, and organisational development unusual areas for design practices (Jones & Kijima, 2018). Therefore, design process such as Systemic Design must be approached as a method for synthesis in wicked problem-solving through a collaborative system redesign (Pourdehnad et al., 2011). Moreover, Jones (2018) has stated that the Systemic Design method for co-design is developed in three phases firstly formulating models, secondly recognising systemic principles, and lastly evaluating by constant for improvement.

Christakis and Bausch (2006) indicate that systems co-design distinguishes stakeholders as designers as it is focused on the collaborative participation of individuals in design-led practices. Other scholars approach co-design practices (Bødker & Grønbæck, 1991; Manzini & Rizzo, 2011) as prototypes to envision potential futures sharing a systemic perspective. The structured approach of Banathy (1996) recognises all stakeholders as designers able to developing strong designing communities, bringing a systemic approach co-designing social systems that can design and redesign themselves.

That systemic mindset is an approach to democracy that can empower and transform societies through design (Jones & Kijima, 2018). On that view, that participatory and co-creative approaches strengthen social aspects required to address CE wicked problems (Table 2.3).

The co-design approaches implemented by the Systemic Design methodologies provides a common understanding of complex problems and sharing responsibilities to cope with change, participatory approaches enable resilient conditions to build adaptive CE governance and resilient systems.

2.4 Policy Design as leverage for systemic policies

Based on the previous, it is clear how the design disciplines a close relationship with the field of public policy. Several scholars agree that governments and institutions translate their political vision designing public policy to accomplish determined goals, present solutions to wicked problems and develop the effective resource use (Birkland 2001; Raulik-Murphy & Cawood 2009; Hobday et al., 2012).

On that view, what are the main features of policymaking as a process? Policy development involves a spectrum of stakeholders and relationships on the given socio-technical system. Such governance mechanism outlines the instruments and processes that allow the political system to execute plans into concrete actions (policies). Therefore policymaking is conceived as a process model or policy cycle which can be influenced by various limitations, timing, resources, government judgments and the iterative constitution of the process itself. According to Knill & Tosun (2008), the policy cycle (Figure 2.4) consists in five steps :(1) agenda setting, (2) policy formulation, (3) policy adoption, (4) implementation, and (5) evaluation (Table 2.5). A policy cycle starts with the classification of the wicked problems and its position on the policy agenda. Afterwards, policy proposals are drafted for subsequent implementation. Ultimately, policy impacts are measured and evaluated. This closing stage leads back again to the first one, meaning that the policy cycle is constant and infinite (Maffei et al., 2013), which means the process can always improve. However, as discussed before the governance process is repeatedly threatened by wicked problems constraints that inhibit an effective decision-making process.

So how the Systemic Design can address the wickedness on governance processes? As society evolves faster today, governments struggle more and more to adapt to the erratic global changes. This situation is prevailing over time as traditionally governments tend to approach these problems in

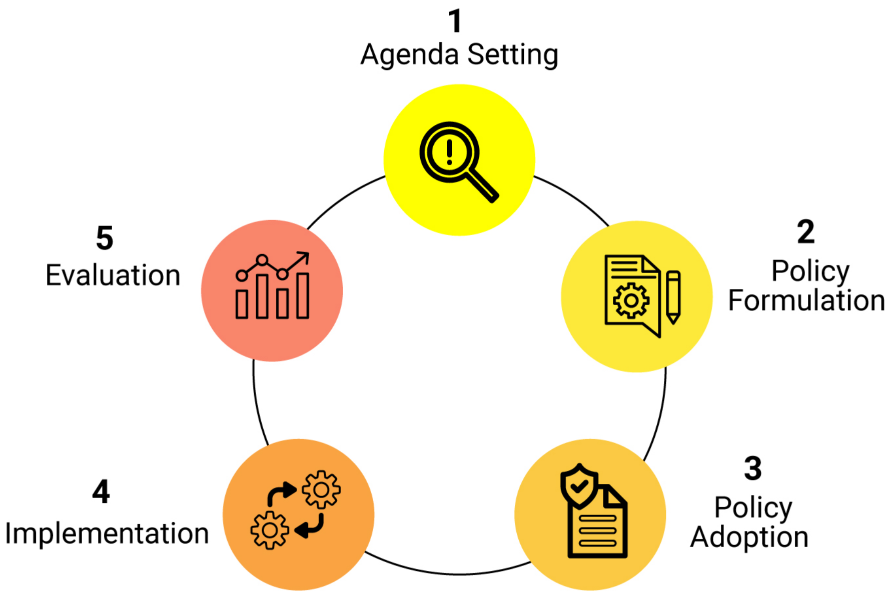


Figure 2.4. A generic policy cycle methodology.

STEPS	DESCRIPTION
1. Agenda Setting	The first stage introduces the description of a societal problem, to be addressed by the governance system. Those wicked problems are determined by the decision-makers who develop the policy agenda.
2. Formulation	The stage requires the description, review, approval or refusal of possible strategies that can respond to the wicked problems.
3. Adoption	The stage is defined by Government institutions settling the adoption of a policy verifying the feasibility of the policy's strategies, approaching considerations on regards values, citizenship interests and public opinion.
4. Implementation	This stage describes the transformation of new legislation and programs towards implementation. The success of a policy strategy relies on the execution of the bureaucratic structures on achieving government mandates. On this phase top-down or bottom-up approaches influence the outcomes.
5. Evaluation	This stage defines the quality, purpose accomplishment, programme effectiveness, impacts, and expenses of a policy strategy.

Table 2.5. A generic policy cycle steps

"silos" and instead of fostering preventive policy systems, often they opt for reactive measures. Hence, the current policies which are aimed to regulate such systems on different levels (local, regional, national, and international) are missing a wide range of factors (OECD, 2019).

The current focus on policies is not the most efficient since it entails a top-down approach that does not take into account the final users, which are the citizens, even though the main purpose should be *"Policymaking is the process by which governments translate their political vision into programs and actions to deliver "outcomes" - desired changes in the real world"* (Blair & Cunningham, 1999).

As our system challenges have turned into more wicked, the design discipline on its problem-solving nature has broadened its approach to services and systems (Ceschin & Gaziulusoy, 2019), by extending to a more expansive network of actors and co-design practices. On that path Design discipline, is more embedded in the everyday complexity, a system with infinite relationships that connect people, companies, and governments. A scenario in which the designer can intervene with its skillset and problem-solving approaches to assess the wicked problems of the everyday system encompassing a variety of alternative frames (Van Manen, 1990). As a result of this approach on wicked scenarios, the design community attention has been addressed into collaborating with governments (Villari, 2012).

These Policy Design strategies have risen in the last 20 years within the implementation of service design to public service delivery and the co-design of services with civil society. That phenomenon is has been reported by government and research bodies, arguing for an expanding role for design in the development of public services and policy. Reports from organisations within or close to government argued for an increasing role for design in the development of public services and policy (i.e. OECD 2019; Design Council 2013; European Commission 2013). Discussions concerning design's importance in the context of policymaking and governance are grounded in the awareness that policymakers continuously have to deal with 'wicked' problems.

The increasing interest from public servants in design in policymaking comes from design expertise innovations in organisational practices which have become more noticeable as a useful approach for public policy (Boltanski & Chiapello, 2005). Today such approaches are required on the current governance system that posses profound failures on the policymaking approach of wicked problems (Clarke, 2004). As explained above, such challenges come the current policymaking nature, which is more reactive than proactive trying to fix the problems instead of preventing them (Howlett & Ramesh, 2014) , in particular this are issues that are present in the current policy cycle.

However, Bason (2018) argues that design can only operate towards making governance visible if designers can fully acknowledge the nature of governance: *"One could argue that the political, ideological and sometimes abstract nature of public policies makes them unfit for design practices which are concerned with that which is attractive, functional and meaningful to people in practice. While the ability to give shape to abstract concepts and ideas is a core design skill, can designers come to terms with the sheer scale, interdependence and complexity of public problems? Can they contribute to the domains of law and governance?"*. Others like Chen et al. (2015) argued on the inadequacy of designers to operate on such a large scale, as in the public policies domain (always detected by the social science), since they are historically focused on the small scale of a product or service.

So the convergence of design practices and policy settings has received mixed assessments. On the one hand, designerly methodologies are seen as having the potential to improve policymaking to address public issues, to contribute to a more accurate understanding of policy processes, and to create more skilful policy professionals. On the other, design's traditional focus on experiences and creative generation neglects deep understanding of systemic contexts and may feel at odds with prevailing organisational culture and practices.

To approach the "desired changes," it is essential to regard both approaches: design and policymaking as a problem-solving process. Consequently, is necessary to implement new strategies like the ones on Policy Design which are based on different design methods from design thinking, co-design and SD, which provide a different overview of understanding policy problems that address long-term vision and strategy (Bason, 2018). Furthermore, facilitating the needed system overview also implies a network of multiple relations on which policy planning aimed to enable such issues (Maffei et al., 2020).

Design methods have evolved into policy and governance thanks to diverse stakeholder engagement such as the quadruple-helix. Co-Design for policymaking has become an innovative field of research for scholars and practitioners, introducing a field for design practices to be implemented in the development of policies to promote an envisioned sustainable future (Ingram, & Schneider, 1993; Soss, 1999; Hendriks, 2009; Kimbell, 2015).

To clearly understand the relevance of the design discipline in the policy field, Bason (2018) explains that design provides a diverse way of understanding policy problems. In his view, the design is intended as a hybrid blend of research methods from different disciplines like anthropology, systems thinking, and data science, through cooperation among different stakeholders. Other authors like Christiansen and Bunt (2014) make a similar affirmation defining the usefulness of design to cut the distance between policy and implementation (Mintrom & Luetjens, 2016). Besides, this kind of policy planning method considers vital that bottom-up and top-down approaches must find ways to coexist with a common objective (Krauz, 2016) (see methodological approach in Chapter 3). From that perspective, it considers all the actors involved in the policymaking process should be able to communicate and work together with the same goal, on a quadruple helix perspective.

On that view, there is an increasing amount of literature on design in policymaking, which examines the use of design approaches in policymaking teams or "policy labs" (Kimbell & Bailey, 2017) which are a tangible demonstration of this process (i.e., Public Policy Lab in New York, EU Policy Lab in Bruxelles, The Policy Lab UK Cabinet Office). Most commonly are configured inside government administrations and are facilitated through co-design strategies or collaboration toolkits (i.e., IDEO cards). Consequently, it makes policy tangible for all stakeholders in a decision-making process. At the same time, it promotes a horizontal dialogue among all stakeholders, generating innovative and effective decision-making for Policy Design approaches. This engagement of stakeholders supports an exchange of strategic thinking process that leads to the definition and implementation of adequate policy planning for value creation (Mortati et al., 2014).

For a Policy Design practice for a CE, it is imperative to address the issues on value creation in our system. On that perspective, SD can make more effective such practice as is capable of tackling complexity at the scale of government and present a more widespread scenario on policy implementation. Additionally, SD presents a diverse system overview for the development of policy within the problem solving by system mapping. The SD, it overcomes the problem of the small scale through a holistic approach. Thanks to this, it is possible to shift from the small to the large scale constantly and to focus on a particular policy or intervention, while taking into consideration the bigger picture. Starting from the system mapping and highlighting problems and opportunities for intervention, the SD provides a different perspective of a specific context.

On that way the new implementation opportunities arise from a profound and detailed comprehension of system scenario, conferring distinct viewpoint on a territory towards new possibilities, instead than merely producing on present notions of a particular wicked problem to be solved. To achieve these participatory processes and design effective policy strategies, the SD involves other methodologies such as design thinking, co-design, user-centred design, and participatory design (Jones & Kijima, 2018). These approaches have in common the active engagement of users, generating an innovative decision-making process which turns the end-user into the focus of the policymaking formulation system (Allio, 2014). The SD expertise provides a method that is focused on the holistic analysis of territory, allowing the design discipline to serve as a mediator among technicians, economists, humanists, and others (Celaschi et al.,2013: Veneziano et al., 2018), generating autopoietic open systems based on contextual values (Mortati et al., 2014). Furthermore, this method merges human-centred design inside complex, multi-stakeholder systems (Jones, 2014) which can highlight the potential opportunities for value creation, delivering new collaborative relations among the local actors and entities (Barbero, 2017). As a result, it proves to be an effective method to deal with complexity and problems interconnections.

POLICY CYCLE STEPS	SD METHOD STEPS
1.Agenda Setting	1.Holistic Diagnosis 2.Definition of problems & leverages for change
2.Policy Formulation	3.Design the system
3.Policy Adoption	4.Outcomes Evaluation
4.Implementation	5. Implementation
5.Evaluation	6.Results analysis & feedback

Table 2.6 Systemic Design steps supporting Policy cycle stages.

The capabilities of SD can serve effectively to the components of participatory co-design that Policy Design processes require. On that view, SD favours the visualisation of opportunities for value creation, enhancing the active collaboration between stakeholders, and boosting locally-based value chains (Barbero, 2012). The policy design process takes place on the above mention its six main steps of SD (Figure 2.3). This process is embeded to the described policy cycle (Figure 2.4). Therefore on Table 2.6 allows to have a have a better understanding on how the SD and a policy desing process overlaps. The policy design process (or policy cycle) takes place on the above mention its six main steps of SD (Figure 2.3). In fact, the policy cycle process (Figure 2.4) can be strongly supported by the SD steps. Therefore on Table 2.6 allows to a have a better understanding of how the SD and a policy design process overlaps. On that view, it is possible to realise that SD steps 1 and 2 can be an influential tool for the policy cycle step 1 as it can deliver more effective targets to address the wicked problems. Additionally, the Policy Formulation stage approached with SD step 3 delivers a holistic review of policy strategies towards a more resilient system. Then for the Policy Adoption stage on the view of SD step 4 can provide a broader feasibility evaluation of the environmental, economic and social benefits, implying a governance foresight vision. On regards, the implementation steps the SD can support the policy cycle on the program development to execute short and long term policy plans that should create local value. On the last step of Evaluation, the SD can support a final stage of a Policy Cycle through an assessment of the implemented system from an autopoietic point of that intends to measure the resilience level (economic, environmental and sociotechnical) of the proposed policy strategy.

Through these steps, SD unveils the hidden value of the socio-economic assets of a territory, creating new valuable relations and synergic linkages, in a long time perspective. Indeed, design capabilities reveal more about the individual and their context and can encourage civil servants to unlock opportunities for an iterative creation of value on a contextual level (Barbero & Giraldo Nohra, 2018).

EXAMPLES OF SYSTEMIC DESIGN IN GOVERNANCE

The SD expertise is rising as relevant to policy design fostering better governance towards CE. An example of this is the RETRACE project (2016–2020) (A Systemic Approach for Transition towards a circular economy) funded by Interreg Europe ETC Programme. This project is perhaps one of the most productive collaboration is between the design research community and governments, where the systemic designer's (practice-led research) becomes a mediator for partnerships, CE policy development, and reciprocal learning. RETRACE aims at promoting SD as a method for local and regional policies to move towards a CE, according to which waste from one productive process becomes an input into another, preventing waste to be released into the environment. Strategic cross-cutting projects like RETRACE are conceiving new field where designers can actively co-develop and propose new policy opportunities towards a CE (Barbero, 2017; Barbero & Giraldo Nohra, 2018; Giraldo Nohra et al., 2020).

There are other SD implementation cases, on a policy design level, in projects or regional initiatives. Even though the design has still a long way to be recognised as a powerful means in a governmental environment, there are examples of innovation agencies worldwide that have similarities with the design approaches, at different governance levels:

- *MArs solution lab (social innovation lab):* Based in Canada, brings together governments, industry, non-governmental organisations, academia, and community to assess complex problems from the citizens' view. They collaborate with multiple stakeholders to develop, prototype, and scale new solutions and create opportunities to learn how to shift the system and local policies.

- *The Finnish Innovation Fund - Sitra (National Agency):* is a future-oriented organisation that promotes Finland's competitiveness and the well-being of the Finnish people. It has aimed at anticipating societal change, fostering innovative models and boosting business that aims at sustainable development. Sitra focuses and assesses the social change and their impacts on Finland's policies.

- *OECD- Observatory of Public Sector Innovation (Intergovernmental Agency)*: It is focused on asses and review examples and shared good practices of public sector innovation to deliver practical advice to governments on how to make innovations work.

These examples illustrate how the systemic approach is delivered in similar ways at different scales. Also, they prove there is an ample room for SD to grow on policy design field: by integrating it into governmental agencies, SD can have an impact on the policy a micro and macro scale. These increasing practices aim to shift the role of public investment generating policy imperatives for governments seeking smart growth and wealth creation.

Nevertheless, it is true that on the current Policy design field, the application of SD still has a lot to explore as an emergent discipline. The involvement of designers in policymaking today faces the current linear governance system differently, by leaving space to the openness and cooperative methods of design. Certainly, SD will confront resistance from civil servants and public institutions as it provides a sharp judgment of current governance culture and practices. In addition to that, governance topics have traditionally developed "behind closed doors" away from the view of the public (Kimbell,2015). The fact that SD attempts to include a quadruple helix can be problematic, as this includes non-government stakeholders that do not know the realities of political decision-making. As a result, this could bring into the process unrealistic expectations regarding the possible transformation that is possible. On that view, the proposed approach of the SD must be able to balance the non-government stakeholders' participation and a policymaking process that can acknowledge the multiple perspectives (Barbero & Giraldo Nohra, 2018).

Lastly, the demand for immediate solutions that policymakers require differs from the long-term view that innovative action needs. In particular, policymaking entails a political decision-making process which usually involves robust discussions and disagreements that are unavoidable, due to the spectrum of different views. On that rough scenario design methods proposes a collaborative working dynamic that seeks common ground and not necessarily what each stakeholder is attempting to accomplish. However, a starting point driven by SD on towards problem-solving can disrupt the traditional democratic decision-making culture (Kimbell, 2015).

According to Bailey (2017), the SD approaches to CE policymaking can thrive under particular conditions:

- A policy space where long term transformation is the goal and decisions do not depend on the political election.
- In sectors where stakeholders are not radicalised, whose collaboration and constructive participation will be problematic.
- A space to innovate and define wicked problems.

From the SD' features outlined above, it is important to highlight their future-oriented vision, social vein and capacity to deal with wicked problems. So policymaking has to deal with long-term vision and strategy. So, the critical feature that connects designers to policymaking is the human-centeredness, as both are on the quest towards a better future for society. Furthermore, designers can support the process of policymaking by stressing not only on numeric trends but also on qualitative aspects such as culture, uses or local resources which is crucial for the development of a CE in a city landscape.

2.5 Addressing Circular Economy barriers with a Systemic approach

On that view, in this era of the climate crisis and a linear economic system, the need for SD and the potential of innovation CE policy and wicked problems has never been greater. As seen in Table 2.3, most CE wickedness of the current scenario comes from the lack of value creation. So as discussed on previous sections, from a methodological point of view, the SD aim is increasingly understood as practical and necessary within the Policy Design for the CE, as government bodies are aware of the need to adopt anticipatory actions on governance that take policy planning one step forward to achieve sustainable territorial development.

	SD METHOD STEPS	CE CHALLENGES	CE CHALLENGES ADDRESSED BY SYSTEMIC DESIGN
1	Holistic Diagnosis	Mapping complex cross-sectoral systems to provide information for decision-making	This analysis aims to deliver a comprehensive system perspective of the scenario, from the quantitative to the qualitative perspective. Delivering a complete overview of data and the total amount of resources and stakeholders the system implies to address a cohesive circular model.
2	Definition of problems & leverages for change	Lack of accuracy on addressing all the relevant assets/ sectors to transition to CE	After approaching a system perspective, the definition of challenges and leverages will be more accurate because the future CE will be addressing and exploiting aspects tailored to the territory.
3	Design the system	Challenge to design innovative and sustainable socio-technical systems	Re-design the current system perspective . Having in mind CE strategies that will valorise all territorial resources. Promoting a systemic transition to CE.
4	Outcomes Evaluation	Need of a long-term vision of multi-governance policy strategies	An assessment of the environmental, economic and social benefits , implies a foresight vision on the CE strategies.
5	Implementation	Incapability to execute in a long term sustainable innovation actions	Apply the proposed system in the given context, and this will imply the implementation of short and long term CE strategies. The purpose of this is a gradual transition to a CE system that will deliver more realistic and consequent feasibility of the new economic activities.
6	Results analysis & feedback	The need of horizontal dialogues between the quadruple helix components	The assessment of the implemented system and ensuring autopoietic is the ultimate proof to know a territory has transitioned to a CE.

Table 2.7 Systemic Design methods related to Circular Economy challenges

With this in mind, it is possible to comprehend what potential levers must be regarded when promoting a transition to a CE in a territorial system. Therefore the SD is understood as a method that can comprehend more holistically the implications that CE has in a given scenario. For that aim, the SD can identify and comprehend the CE barriers and levers from a systemic thinking point of view. Afterwards, it unleashes the potential strategies that can promote an autopoietic and resilient system. So to comprehend better how SD method addresses the CE barriers, the (Table 2.7) explains how each SD step addresses specific CE-related challenges.

That analysis brings an overview of how the SD offers a practical approach to the policymaking process on CE. Lastly, it is to underline the key role of the systemic designers since they were the experts that provided the methodology. As providers and mediators, their flexible role allows a Quadruple Helix approach where university, industry, government, and civil society cooperate to co-develop strategic decision-making processes.

2.6 A Policy Foresight to sustain and Scale Circular Economy strategies Systemic approach

How can SD implement with a long- term vision CE policies? In our current era of unpredictable societal and environmental transformations, governments need to be more future-oriented than ever before. While on the one side, society seeks to be affected by quick changes to tackle everyday issues, on the other side a long-term vision is necessary to anticipate unexpected and disruptive events that often occur (Maffei et al., 2020), like natural disasters or economic crisis, generated by critical drivers such as climate change, poverty and market instability all related to CE. These wicked problems (Table 2.3) are just the visual expression of the complex phenomena that characterise today’s world, which leads to an inevitable uncertainty.

STEPS	DESCRIPTION
Framing	Scoping the project: attitude, audience, work environment, purpose, objectives
Scanning	Collecting information: the system, history and context of the issue and how to scan for information regarding the future of the issue.
Forecasting	Describing baseline and alternative futures: drivers and uncertainties, implications and outcomes.
Visioning	Choosing a preferred future: envisioning the best outcomes, performance measures.
Planning	Organizing the resources: strategy, options and plans
Acting	Implementing the plan: communicating the results, developing action agendas, and institutionalising strategic thinking and intelligence systems.

Table 2.8 A generic foresight methodology. Source: Bishop et al., 2007

As mention before, policymakers are increasingly using anticipatory strategies and tools to tackle social, economic and environmental issues. Among these, strategic foresight has been used since the 1970s, through the evolving conception of future thinking: *"from a predictable world of controlled solutions to an unpredictable world of continuous learning and rapid adaptation through redesign and innovation"* (Wilkinson et al., 2014)

On that view, strategic foresight has been initially used by the industry as "corporate foresight". This method is applied to better address decision-making by looking forward into the future. Since 1990 it has broadened its domains to public policies given the higher complexity of today's globalised world. In particular, it has evolved from being a linear forecasting approach to be conceived as an ongoing series of efforts that illustrates what could be the possible futures and what is necessary to realise these (Rohrbeck et al., 2015). A generic foresight methodology can be summed up in the six steps outline in the Table 2.8.

It is important to stress the fact that foresight is not used to predict the future, rather understand what could be the multiple futures that may occur and the value of learning from these. Through identifying and studying the change drivers, it is possible to be prepared for the opportunities and threats of tomorrow, in order to develop in advance the best strategy to adopt (Maffei et al., 2020). As Vecchiatto (2012) said: *"it is a planned learning process that requires strategic agility and adaptive capability about the future in order to react more quickly and more effectively to external opportunities and threats as they arise."* This means to continue re-assess and re-align the project (or the system) boundaries. For this reason, strategic foresight requires a broader, flexible and open mind people able to navigate through the multiple scenarios that emerge from the changing of variables. As remarked by Wilkinson et al. (2014): *"In times characterised by low predictability and inevitable surprise, the capacity for anticipatory adaptation, resilience and self-transformation is now seen as the key to long term success."*

An adaptive mindset and the ability to navigate through multiple scenarios, is something proper of systemic designers, as mentioned above. Foresight projects tend to account for systemic changes in the search for a future ideal state (Jones, 2014). As discussed above, the practice of looking forward into the future is something shared from futurists, designers, and policymakers.

From a foresight approach (Table 2.8), it is interesting to recognise how similar is the methodology adopted by designers when approaching a new project. Both futurists and designers start with scoping the context: the identified problems and the collected information are delivered under the shape of a scenario, which describes the most plausible futures. After choosing the preferred future to define the new project, a strategic plan is developed in order to be translated into new solutions that should be later implemented through an action plan (Wilkinson et al., 2014). If, on the one hand, sometimes it has

been criticised to futurists the lack of action after pointing out new possibilities, on the other hand, designers, are accused of performing a short-term vision that does not favour sustainable development. Admittedly, it is essential to acknowledge how the similar methodological approach shared by futurists and designers can be considered a crucial common ground of cooperation, on the lead of a multi-stakeholder group of policymaking. On that view, it can be considered that the systemic designers could be the right expert to involve in order to overcome the challenge of performing only a short term view.
From the previous, it can be understood the ongoing synergies between SD process and the Foresight framework (Table 2.8). Most certainly, both processes share common points that are those which this paper is outlining, such as:

- *Intrinsic future orientation:* as suggested by the etymology of both names: "fore-sight", which means "seeing ahead, knowing in advance" and "pro-ject", which means "to set forward" (Hines & Zindato 2016).

- *To conceive multiple futures/solutions:* because everything changes, so it is not about solving a finite problem, instead of tackle the multiple problems that emerge from the changing of variables. Complex systems define a class of problems that are often described as non-linear, adaptive, self-organising and emergent (Hadzikadic, 2015).

- *To deal with complexity*, and with wicked problems that characterise today's global challenges (Rittel & Webber, 1973).

- *Continue re-assessment and re-alignment of the project (or of the system) boundaries,* always questioning about present assumptions (Weigand et al., 2014).

- *Micro/macro scale,* SD can shift from the specific intervention to the broader context on which this intervention is set. (Bistagnino, 2016)

- *Short/long term,* SD can deliver solutions on the short, medium and long term by developing a strategy on multiple scales. (Bistagnino, 2016)

- *Open to a collaborative process of multi-stakeholders* since complex problems cannot be solved in isolation but require the cooperation among science, humanities and technology. (Bason, 2018)

Among the tangible deliverables shared by the two disciplines, other connections are seen through the use of:

- *Scenario:* a powerful visualisation of possible or desirable futures with a robust system thinking basis (Ringland, 2010; Godet, 2010)

- *Action plan:* which materialise the strategy previously developed into a series of actions necessary to achieve specific objectives. This document should also specify the timeline, the actors involved and the expenses (costs or funding)(Barbero, 2017).

- *Roadmap:* primarily used in policymaking since it specifies the concrete actions and programmes to address a full-scale implementation, shared by policymakers and stakeholders (Kimbell & Bailey,2017).

Literature and the field of practice have shown the intersection points between foresight and systemic design practices. Since tackling CE, a wicked problem is an evolving process that requires multiple change-makers able to face with complexity. Therefore it is necessary to explore how the systemic designer mindset and methodology can be supportive of a CE policy cycle that includes foresight practices and strategic decision making. On that view, What strategic foresight and SD have in common, is the capacity to question about past always, present and future conditions by continuously re-discussing our assumptions. In the case of a policy cycle in municipalities, both SD and foresight envision plausible futures and try to strategically design multiple policy solutions aiming to reach an exponential CE future in cities.

2.7 Conclusions

This introductory examination phase addressed the first objective of this project, 'To critically review literature on System Transitions, Design for Sustainability, Systemic Design, Co-design practices and Circular Economy Policy Design'. Such review enabled to identify a knowledge gap and the development of a conceptual framework which will conduct the following phases of this research.

The literature reviewed contributed to setting the scope of this research around CE policy design and outlining the problem to be investigated, i.e. the need to investigate in which ways a Systemic Design approach to CE policy can establish a more inclusive and cohesive policy design process (or policy cycle) for a circular model relationship with the context to develop local value.

In order to provide background for this research, a picture of the wicked problems of CE was drawn, allow us to comprehend the nature of the current issues of the governments which address such problems linearly. Therefore, the wickedness of the current scenario comes from a lack of value creation. So to tackle the wicked problems rooted in the CE governance, this examination adopts systemic thinking and a holistic approach to innovation in CE policy. From this view, the research argues that the Designer acquires a vital role towards sustainable development, which is underlined by his/her competences and high skills as a "mediator" on the approach of complex systems collaborating with many other experts.

The result of the application of Systemic Thinking to the design discipline narrows the examination towards the SD discipline which addresses wicked problems in complex socio-technical systems within a holistic approach applied to projects for artefacts and services. In particular, for this research project will be implemented the Politecnico di Torino SD approach, which provides systemic and interconnected solutions to the complexity of the current situation, encompassing economic, environmental and social contexts. In particular, Holistic Diagnosis" was discussed as a prominent method to be applied, in order to activate essential paths towards a resilient system. Such an approach recognises the increasing need for a quadruple helix (a combined top-down and bottom-up approach) to cooperate in order to address such CE complex challenges, co-design approaches were here bridged with Policy Design, an under-explored area of research.

With this in mind, the capabilities of SD can serve effectively to the components of participatory co-design that policy cycles require. On that view, SD favours the visualisation of opportunities for value creation, enhancing the active collaboration between stakeholders, and boosting locally-based circular value chains, in a long time perspective requires further investigation. Furthermore, systemic designers can support the process of policymaking by stressing not only on numeric trends but also on qualitative aspects such as culture, uses or local resources which is crucial for the development of a CE in a city landscape. For that aim, the SD can identify and comprehend the CE barriers and levers from a systemic thinking point of view. Afterwards, it unleashes the potential strategies that can promote an autopoietic and resilient system.

Moreover, literature and the field of practice have shown the intersection points between policy cycles, foresight and SD practices. Since tackling CE wicked problems is an evolving process that requires multiple change-makers able to face with complexity, is necessary to explore how the systemic designer mindset and methodology can be supportive in CE policy foresight practices and strategic decision making in cities.

For the objective of this research project, the framework was developed through two case studies, with the aim explore how SD approach can support a Policy Design process on Circular Economy towards a Circular City model in a post-industrial precinct.

Chapter 3

Methodology

This Chapter introduces the research methodology of this investigation; it describes the research purpose, type, strategy and design. Including data collection methods from Literature Review to the Systemic Design methodology determined to address the research aim and objectives drawn in section 1.3.1. (Figure 3.1)

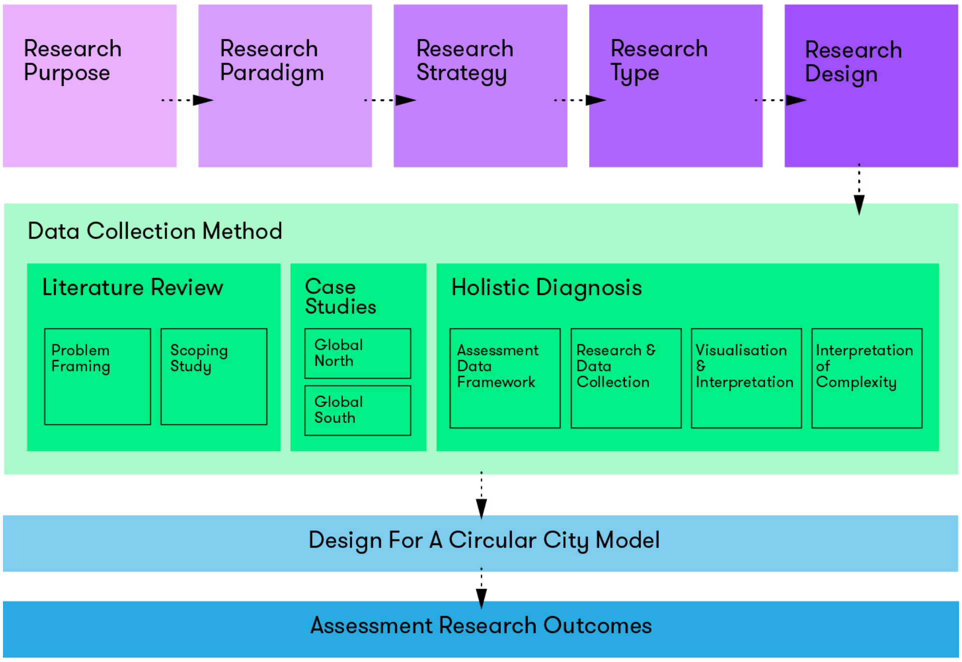


Figure 3.1. Research methodology scheme Chapter.

3.1. Introduction

To accomplishing a research process means to create new knowledge. Such processes require data gathering, analysis and framed outcomes that can be supported by various methodologies. Therefore they are determined by the research scope and disciplinary domain that address the methodologies of data gathering and analysis to apply in the research process (Davies, 2007).

According to Robson (2002), research can be approached on two perspectives as a "closed" or "open" systems. For instance, laboratory research is interpreted as a "closed system" type, as are artificially established outside influences are omitted, and elements are controlled and determined. On the other hand, "open systems" approach is interpreted as research in the 'real world' - or 'the field'. As the complexity of outside influences is embraced and due to this unpredictability, the research unveils during the process.

Social researchers (designers) carry out most investigations in the 'real world', and the main critical challenge resides in the uncontrollable variables the outside context - the openness of the approach -. Furthermore, realism[1] acknowledges that in social science, it is unlikely to address that point of closure (Bhaskar, 2013). Considering that, to accomplish a research process in an 'open system', the real-world researchers will require innovative approaches that can be flexible and suit the purposes and setting of the research task. With this in mind, the essence of this examination comes from real-world research approach, where design is presented as a discipline to approach an 'open system'. (Robson & McCartan, 2016).

3.2 Research Purpose

After framing the research problem in the previous section, the research purpose determines what specific knowledge will be generated and the goal of the study. Several authors have defined a commonly used classification of the four research purposes more distinguished which are; exploratory,

1. The principle of realist philosophy of science; perception provides access to things and experimental activity access to structures that exist independently of the researcher. (Bhaskar, 2013)

descriptive, explanatory and emancipatory (Marshall & Rossman,1999; Robson 2002). Based on those authors, a brief explanation of such categories:

- *Exploratory:* This approach suggests, that research is conducted to overview the state of context, particularly in little-understood situations. To find innovative insights and questions, then asses new phenomena to create ideas for future research.

- *Descriptive:* This research focuses on frame an accurate profile of persons, events or situations. It requires extensive previous knowledge of the situation through a process of data collection. The main goals are describing, explaining, and validating the outcomes.

- *Explanatory:* Research is conducted to understand the impact of a situation or problem, traditionally but not in the form of a causal relationship. To explain patterns relating to the object of research and identify relations between its aspects.

- *Emancipatory:* This approach implies, that research is conducted overview the state of context, in order to create opportunities and the will to engage in social action.

Therefore, the investigation's research purpose was exploratory, as it investigates innovative insights concerning a little-understood phenomenon. This choice came from the contribution of Systemic Design in the context of post-industrial areas which has not yet been examined. Especially in the focus of embracing a policy design lens to activate a transition towards a Circular City.

3.3 Research Paradigm

The research paradigm defines the approach in which the researcher will study given phenomena. At the same time, it confronts the study of the social sciences that is not so pertinent in the natural sciences—leading to introduce the question of the status of the human subject and researcher and the status of social phenomena (Walliman, 2017). On that view, from a the existing research paradigms such as positivism[2], realism[3], interpretivism[4] and pragmatism, been the last two the most relevant to social scientists.

In particular, this research project was carried under a pragmatism paradigm. This investigation approach accepts concepts to be relevant only if they support action - findings with practical consequences-. The pragmatism considers that research outcomes can not come from a single perspective, as there may be multiple realities (Robson 2002; Reichardt & Rallis, 1994). Meaning it can combine the use of multiple research types such as qualitative and quantitative methods, through different data collection techniques, generating reliable and relevant data that can support subsequent action (Saunders & Tosey, 2013). In the particular case of social sciences, the use of pragmatism can enable a unique insight

2. Positivism; This approach to scientific research is based on the recognition that the world around us is real, and its characteristics are accurately measurable. Also, it contains an order of discrete and observable phenomena, that can not be influenced. As, the philosophical position of the laboratory scientist, knowledge is acquired from applying the scientific method and based on tangible experience obtained through experiments or comparative study, to predict outcomes and to describe generalisations and develop scientific facts to build up knowledge (Walliman,2017).

3. Realism: This approach is based on the idea of independence of reality from the human mind. So it requires the supposition of a scientific approach to the development of knowledge. Realism can is divided into two categories: direct and critical.

4. Interpretivism; This approach relates to the study of social phenomena in their natural environment. It states that the view of the world perceived is created through the perceptions that are influenced by the human preconceptions, beliefs and values; there is no disembodied spectators but part of the society (Walliman,2017). Meaning that it focuses on investigating subjects to understand their social world and the significance they give to it from their point of view in order to research for highlights in the human behaviour that can contain repetitive and predictable characteristics of a society (Saunders & Tosey, 2013).The role of the researcher is to undertake the investigation's phenomena to emerge from the examination process rather than discover universal laws. Consequently, there can be multiple perspectives and interpretation of a phenomenon (Thomas, 2009).

into a complex social phenomenon which is not accessible approaching from either type of data alone. This joint use of qualitative and quantitative data is defined as “mixed-methods” (Johnson et al. 2007).

With this in mind, this investigation aimed through a pragmatist way a systemic approach for decision makingin Circular Cities, byestablishing a relationship with mixed-mode research (Greene, 2007) for post-industrial precincts in order to understand their complexity and multiple perspectives. That approach established that this examination was addressed from an insider’s perspective, interacting with stakeholders of the post-industrial precincts from public bodies, industry and community. In order to capture a holistic approach of the context and understand what leverages for change can serve to reactivate the precinct in a resilient and sustainable way.

3.4 Research Type

Research type is driven by the research purpose and aligned with the paradigm under which the research is carried; it can be qualitative or quantitative driven. In this case, the research project was carried under a pragmatism paradigm, as mentioned before. From that perspective, pragmatism’s model to determine a method’s suitability is to assess it in terms of purpose achievement (Maxcy, 2003). Frequently, such determination of methods in pragmatism is closely related to the research questions. For that reason, pragmatism is known as “paradigm of choices”, as there are multiple alternatives possible to combine the strengths of the qualitative and quantitative methods based on the nature of research (Morgan, 2014).

Despite the distinction within the two types in terms of technique, language and objectives, they can be combined in “mixed methods” (Johnson et al. 2007). Moreover, Creswell and Plano Clark (2007) emphasise the researcher must be capable of justifying the necessity of mixed methods to achieve the purpose and valid knowledge. Additionally, the rigor is must be considered when the investigators report detailed quantitative and qualitative methods to describe their study.

In the case, of social research, this pragmatism enables the most efficient use of mixed methods in attempting to understand social phenomena (Sieber, 1973) which is not accessible approaching from either type of data alone. With this in mind, the mixed-method type was chosen for this investigation which considers; the exploratory purpose, the pragmatism paradigm, the research scope and questions of this study.

Furthermore, to understand the mixed-method approach of this research, it must be conder the System Thinking theoretical lens, which implies applying a qualitative and quantitative approach, in order to map the given context, though a multidisciplinary approach (Capra & Luisi, 2014). On that view, a brief explanation of both research types under a Systems Thinking approach;

- *Quantitative method:* it intends a review of information about the state-of-the-art through different sources, understood as existing scientific literature, official reports, and databases. The analysis is generally deduced from the measurement of causal correlations among variables, regularly in the form of numbers (Byrman, 2003).

- *Qualitative Method:* it is defined as research taken to the place where the collection of data will be developed. Such an approach involves tools and informal activities, such as interviews, observations, and live descriptions of qualitative and quantitative information (Creswell,& Poth, 2016).

Both two types of research methods in the case of Systems Thinking should happen simultaneously, as they complement one another. Such results enable to achieve a systemic mapping visualization of the data helps to ease one’s inductive reading and interpretation of the complexity, leading to the development of a theory or system (Strauss & Corbin, 1990). Nevertheless, the approach must be regarded critically, so to ensure such as knowledge validity it is necessary to verify, in the field, the information found with desk research. This verification is done to increase the level of accuracy of the research and verify if the given data are current. Still, both quantitative and qualitative data are needed to frame a scenario of the research question (Morgan, 2014). In this context, the research project involved from database consultation to multi-stakeholder participation, in order to activate innovative decision-making mechanism in policy design; the purpose was not of testing theories but through the Systemic Design develop a policy design approaches for Circular City model in the context of post-industrial precincts.

3.5 Research Strategy

In order to address a systematic study of the subject of interest is necessary to define a research strategy. To accomplish this, it must consider the previous components such as; research type, research questions, data collection and analysis methods (Robson, 2002). On the side of quantitative research generalized patterns based on an ob jective view of reality, it can be pursued with the following strategies: laboratory experiments, field experiments, field surveys, case studies and secondary data analysis (Bhattacherjee, 2012). In contrast, several scholars have identify the 5 main strategies to pursue qualitative research: case studies, ethnography, grounded theory, narrative research, phenomenology, (Robson, 2002; Creswell ,2007; Bhattacherjee, 2012), which aims subjective studies of social phenomena from the perspectives of the subjects involved.

Due to its pragmatism paradigm and exploratory research focus, this investigation adopted a case study research strategy to lead the examination. So, to have a better understanding of this case study, it is defined as an in-depth investigation of a problem in one or more real-life settings (sites) through a specific period. The data collection applied can be a combination of several methods interviews, personal observations, and internal or external documents, within a qualitative, quantitative type or both. (Thomas 2015, Yin 2004). Demonstrating to be a very suitable strategy for mixed-method research.

A case study can be determined by a single situation, organisation or implementation process, whereas a unit of inquiry can be described as a specific phenomenon study which addresses the research questions. For this investigation, the post-industrial precincts were adopted as units of analysis of a case study around a Systemic Design approach for decision-making for Circular Cities. Hence, as case studies strategy approaches questions that are concerning a current real-world phenom (in this study case: how systemic design can be applied to activate a decision-making process to transition towards a Circular City model) in its present setting (post-industrial precincts)(Yin 2004).

More importantly, a case study strategy suggests to the researcher the option of a single-case or multiple-cases. On the one hand, the single case design is more suitable to examine a current theory alternatively if the circumstance is unusual where before was unavailable for scientific examination (Yin, 1994; Robson, 2002). On relation to this investigation, it did not meet the basis for a single case study, considering the exploration of the application of systemic design approach for transitioning post-industrial precincts towards a Circular City model requested for a more extensive response to reach the examination's aim. In contrast, the multiple-case design suitable for theory testing and for generating diverse explanations of a phenomenon. So that means the reasoning carrying the application of multiple-case studies must be the same. Every case needs to be meticulously selected in order to, predicts similar outcomes (accurate replication) or provides different outcomes solely for predictable purposes (Yin, 1994). On that perspective, this research project adopted a multiple-cases; as the proposed framework evolved during this research enhanced through two different case studies of post-industrial precincts.

Since, the exploratory purpose of this study, this multiple-cases strategy was merged with Systemic Design approach that required the closet cooperation among the researcher/designer and stakeholders to examine a the complex-phenomena within the research setting (Jones, 2018). Also, it demanded that the role of the researcher/designer as an active participant in the project and mediator of the process (Celaschi et al., 2013).

3.6 Research Design

The following phase is to define the research design that focuses on addressing a series of actions towards answering research questions and objectives, turning them into a research project (Robson, 2002). This process included selecting a research paradigm, purpose, type, strategy and methods of data collection and analysis, that enable to produce enough data of the sort that will result in reliable conclusions and adjusted to any limitations of the subject of examination, such as lack of access, existing literature or knowledge (Easterby-Smith et al., 2008; Saunders et al., 2009). In particular, for this project, the research design was conceived in 4 sections – State of the art (Chapter 2), Scoping Study (Chapter 4), two Case Studies (Chapters 5 and 6), and Research Outcomes (Chapter 7). Every part contributes to notify the following part approaching the research aim.

Mainly, data collection methods are applied to address the research objectives and regard how the data is presented as accurate and interpreted. It is possible to apply several methods to gather the same data since different techniques contribute with a different viewpoint of the outcomes being investigated. Depending on the research, the methods can vary their suitability to approach particular research questions, including time and resource restrictions. (Robson, 2002; Saunders et al., 2003). This research project used a variety of data collection methods, applying the more proper to approach the objectives of each step of the examination (Figure 3.2).

3.7 Literature Review

Data Collection Method

This phase aimed to conduct a critical review of the literature on System Transitions, Design for Sustainability, Systemic Design, Co-design practices, Circular Economy Policy Design, to address research objective 1, found in Chapter 2. A map of the literature (Figure 2.1) was developed to guide the literature review, which aimed to deliver a panorama around the most crucial areas linked to the research scope

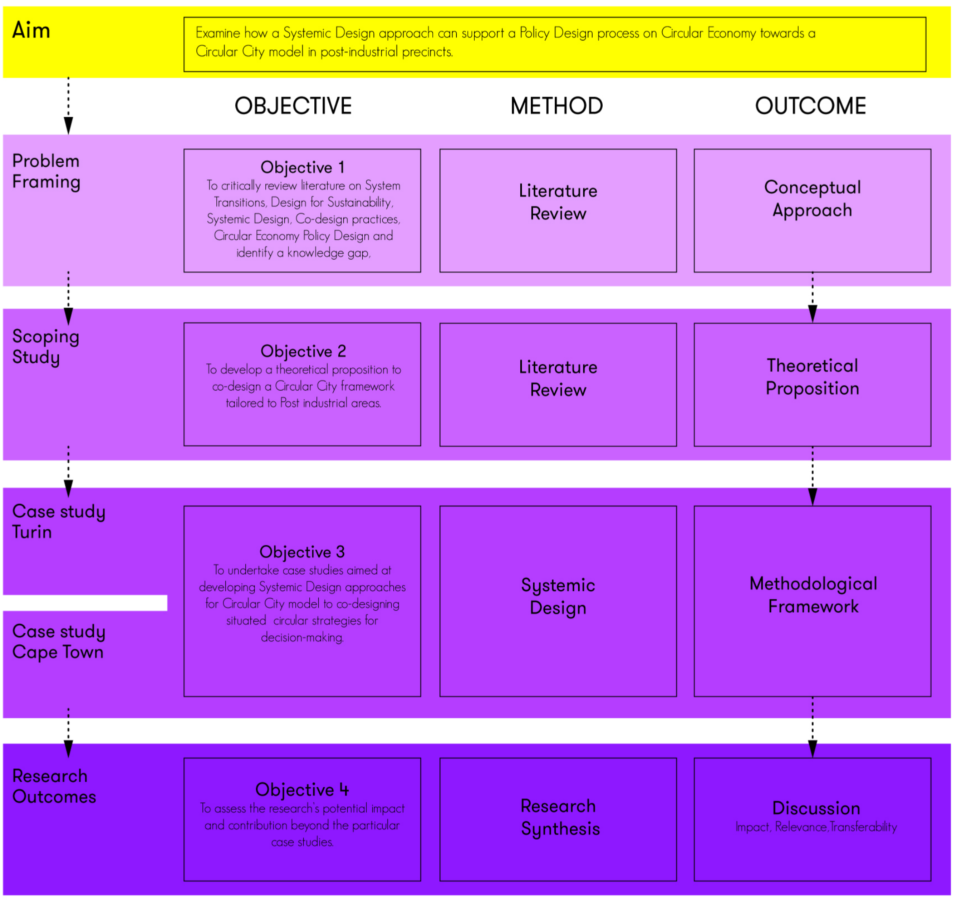


Figure 3.2. Research design of this doctoral project

and present the connections between them. Firstly, to determine the different scientific contributions on the chosen fields, the research was conducted with keywords on primary databases such as Scopus and Web of Science, among other databases available from the Politecnico di Torino and University College London libraries. An extensive review was executed on the primary research domains individually, to conclude and framed the theoretical associations among them, in order to produce a conceptual framework about a Systemic Design lens on Policy Design for Circular Economy decision-making. This process of literature review established a knowledge gap that entailed the application of Systemic Design on the policy-making process and the adaptation of the methodology in local contexts. In order to cover the knowledge gap, a conceptual framework emerged from the literature review. During the project, it was developed and tested at the theoretical level through literature review and in practice inside the two case studies carried applying a Systemic Design approach. Once again in Chapter 4, the scoping study was framed by a specific literature review targeting Circular City frameworks carried to reach a theoretical proposition on co-design for Circular City model, in order to to be applied on both case studies. The purpose the examination was to approach research objective 2, 'To develop a theoretical proposition to co-design a Circular City model tailored to Post-industrial precincts, further aspects on regards the study can be seen in Chapter 4. For that aim, the literature review identified the challenges and opportunities around across Circular City frameworks and recognised one particular framework to scope this investigation. Ultimately, the researcher carried a method of design synthesis of the outcomes into a theoretical proposition to inspire a Circular City model on the Lens of Systemic Design for post-industrial precincts.

3.8 Case Studies

Data Collection Method

For this research was undertaken two Case Studies to approach the research objective 3, '*developing Systemic Design approaches for Circular City model to co-designing situated circular strategies*." Both cases studies were considered under the Systemic Design methodology using multiple methods for data collection and co-design that this approach applies. On that view, in both studies, was applied the same data collection and analysis methods nevertheless developed to support assessment between the studies. On the next sections, it will be further explained the Systemic Design methodology as a core approach for this project, explaining the basis for its data collection methods and analysis such as the Holistic Diagnosis, applied in both the case studies. Furthermore, on section 3.10 Sampling Strategy features the selection process of the case studies showcased in Chapters 5 and 6.

3.9 Systemic Design

Data Collection Method

Within the scope of this project research, the Systemic Design approach from the Politecnico di Torino has been determined as a principal research methodology for data collection and analysis. The approach has described in detail through an extensive literature review in Chapter 2, based on the steps described on (Figure 2.3). On the following section will be focused on describing the methodology steps and how they will be applied to the research project. The Systemic Design methodology passes from the definition of the context to the design of a complex system.

3.9.1 Holistic Diagnosis

The Holistic Diagnosis is the first step of the Systemic Design Method, where the complete overview of the system is addressed, a review of the origins and principles were already approached in Chapter 2. This section will go in detail in the structural and organized process applied in this research project to elaborate, create, generate, configure, draft, and perform the Holistic Diagnosis. In order to frame and reveal problems efficiently in the case studies approached (or any complex context), delivering directions to design a sustainable future—from the research and visualize (Gaiardo, 2016) stages to Assess, Research, Collect, Visualize, Interpret (ARCVI) (Figure 3.3). This classification is in line with the Systemic Design methodology identified by Ryan (2014) and composed of the following steps: inquiring, framing, formulating, generating, facilitation, and reflecting. This approach allows the Holistic Diagnosis to be utilized for the analysis of multiple

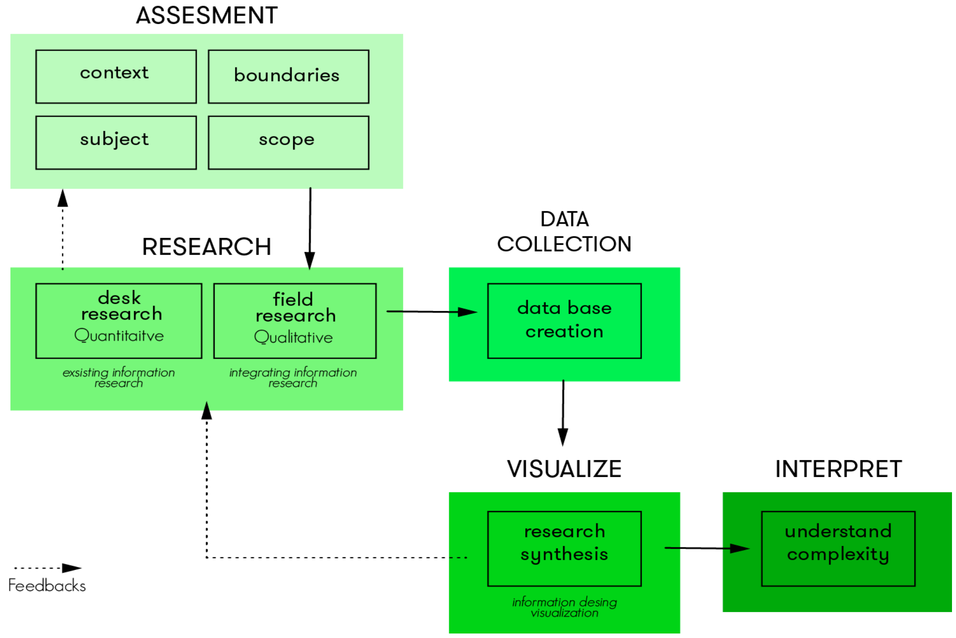


Figure 3.3 Graphic scheme about the **Holistic Diagnosis** process Assess, Research, Collect, Visualize, Interpret (ARCVI). Retrieved Battistoni et al, 2019

contexts simultaneously within multidisciplinary groups applying standard organized information to achieve synthesis results (Battistoni et al., 2019).

Also, the Holistic Diagnosis for this examination will follow the notion of 'Time-Based Design' (Sevaldson, 2004, 2005), which will be essential to the whole framework. This concept relates time to design processes, analyses and scenarios concerning generative systems mapping.

Such perspective allows comprehending environmental, societal and cultural features and processes across past, current and future landscapes. In the case of this examination, post-industrial precincts. On that view, the Holistic Diagnosis intends to co-design and re-design the current complexities of the given scenarios (Davidova, 2020).

3.9.1.1 Assessment of the Data Framework

In order to accurately assess a data framework is vital to understand the scope of the project, which allows defining the boundaries of the system, from the social, regional, urban or industrial system. Nevertheless, "systems rarely have real boundaries" (Meadows, 2011), but humanity has applied them to define infinite concepts according to their expected purposes. Therefore, each project has a prominent theme from where to begin the examination: a particular industry, sector, value chain, or context—the preliminary circumstances for each project frame this starting point. In the case of territories as cities, regions or countries, these circumstances can be determined by political, geographical or cultural edges, depending on the case (Battistoni et al., 2019). In particular, for this research project, the boundaries of the system are determined within each post-industrial precinct. Also, the starting point of observation for both areas will be narrowed in the scoping study of the Circular City model (see Chapter 4). So, to have a better understanding of the preliminary circumstance, the framework considers three main components; Data categories, Stakeholder Identification and Policy Framework Analysis (3.4 Figure).

DATA CATEGORIES

Firstly, data categories are defined by the main aim in the case of this research - post-industrial precincts transition towards a Circular City model - as they will be the lens of the analysis. Those categories are divided into subjects that are determined on the scope of the post-industrial precincts. On that view, the main categories of data utilized for the case study examination were urban fabric, demography, culture and economy (Figure 3.5).

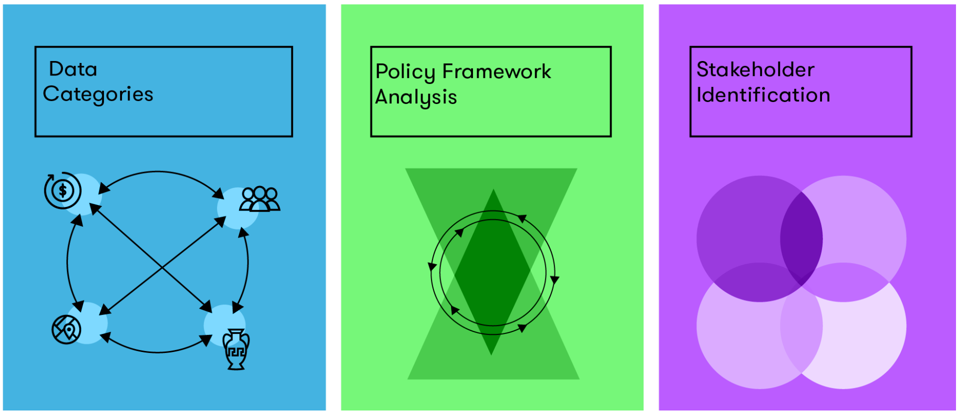


Figure 3.4 Graphic scheme about the Assessment framework elements; data categories , Policy Framework Analysis and Stakeholder Identification.

Such categories deliver a frame for a broad analysis panorama of the precincts. Still, to avoid an overly broad perspective, it was determined a level of detail (subcategories) according to the scope of the investigation and timeframe. These subcategories canalized the bundle of data, to target the scope of the investigation. Later on, they delimited an initial range of the data that was considered inside the examination process (Battistoni et al., 2019). At the end of this stage, the main outcome should be the generation of a personalized format for data collection (see Annexes I and II to retrieve each applied format). In both cases was applied almost the same format. Nevertheless, some modifications were applied due to data availability differences, but this will be further elaborated in Chapters 5 and 6. In the following paragraphs, a more in-depth explanation of the chosen aspects for study in each category.

URBAN FABRIC

The urban fabric part focused both on an understanding of the principal morphological features, natural resources and the use of the soil by anthropomorphic activities focusing on existing infrastructure, urban voids and public services (with a focus on quantity). This examination on each case study aimed to deliver a perspective on the system dimensions from a peri-urban perspective (natural ecosystems surrounding the area) to the developed infrastructure around each precincts epicentre such as factory complex, warehouses, social housing, schools, and public space (Barbero, 2017; Battistoni et al. 2019). The study established a benchmark on the urban fabric framework for each precincts case study; for that purpose, the following categories were determined for the analysis:

- *Infrastructure;* coordinates, surface area, non residential buildings, public housing, density of the built environment, green infrastructure surface , brownfield surface.

- *Urban Metabolism;* Climate/Meteorological data, soil quality, water quality, Energy source, water swage, urban/industrial waste management, public transport.

DEMOGRAPHY

This category aimed to deliver a perspective on the socio-technical system dimension from the collection of general information on the demographic trends over the years. This analysis is focused transformation of the social fabric over the years reflected on static composition, relational isolation, growth of families, poverty across the area, vulnerable population and education (Barbero, 2017; Battistoni et al., 2019). The previous serves to establish a benchmark on the social challenges and potentialities for a precincts case study; the following categories were determined for the analysis:

- *Population features:* numbers of inhabitants, the density of population/average age, mortality

- *Education:* schooling rate, the vocation of studies

- *Health:* chronic diseases, life expectancy

- *Welfare space:* urban safety, access to public space, mobility.

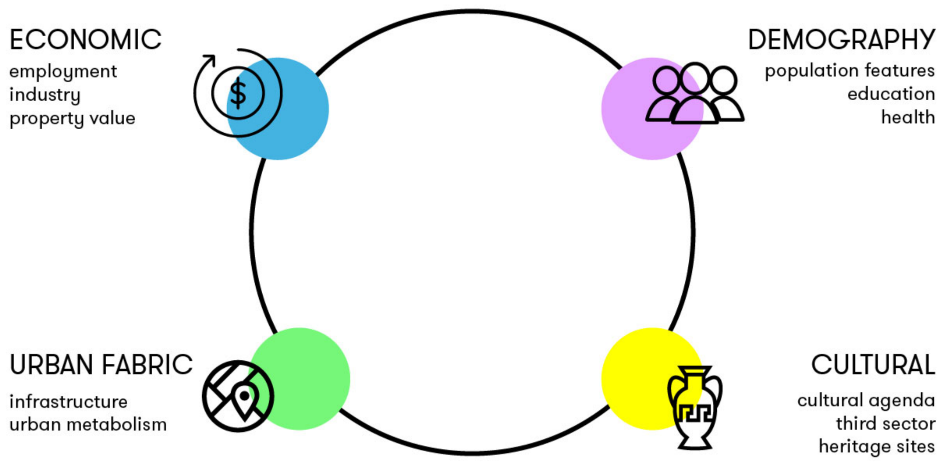


Figure 3.5 Data categories graphic scheme, with of the main categories analysed for the Holistic Diagnosis context for both case studies

ECONOMY

This category was focused general study of the economic indicators of the precincts case study, including from job typology to and property value. The indicators served as measuring instruments of the skills and services present in the area, including the internal organization which resembles the Economically active population (cooperatives, one-man companies). Moreover, an overview of the weak and robust economic sectors, from multinationals to the increasing role of the third sector as a potential force of economic reactivation (Barbero, 2017; Battistoni et al., 2019). As the analysis aimed to focus on areas of innovation related to the Circular Economy for precincts case studies, the following categories were selected for the analysis:

- *Employment:* employment/unemployment rate, job typologies, employment qualifications

- *Industry:* active enterprises, multinationals, retail/supermarket, revenues by household, third sector.

- *Property value:* This focus is an indicator on the shift of the property value over time (00's until now) for residential/commercial/industrial/office use. Considering the monthly cost of basic utilities (electricity, water, garbage)

CULTURAL

This category aimed to deliver a perspective on the cultural system dimension from the historical heritage to the current precincts lifestyles. The aim was to comprehend the influence of industrial precincts on every cultural perspective shaping all aspects from the urban fabric to demographic and economy. On that view, it was essential to identify the activities by local institutions (third sector or local government) that were linked to the local culture from lifestyle to cultural heritage, in order to understand specific phenomena inside the district (Barbero, 2017; Battistoni et al., 2019). As the analysis aimed to focus on the local assets that can enhance more the local culture for a Circular Economy on the case studies precincts district, the following categories were selected for the examination:

- *Cultural Agenda:* Trade Fairs, Symposiums, Concerts, Parades - Decrease of generalized participation, from events to Masses.

- *Third Sector:* Number and type of social enterprises present in the territory at the moment. Considering the different funding and partnerships (e.g. public- private partnerships)

- *Cultural heritage assets & sites:* cultural groups, principal traditions, languages,religions,food traditions, Architecture heritage.

POLICY FRAMEWORK ANALYSIS

As widely discussed in Chapter 2, the need for more flexible policies that can adapt to the wicked problems changing reality. For that purpose, the Systemic Design methodology through the design process provides tools for the definition of complex scenarios, not only serving managing authorities but including the entire spectrum of stakeholders - the quadruple helix-(see next section on stakeholder identification)(Barbero, 2017). This approach is firmly in rooted in the construction of more systemic views of the proposed scenarios, in this case, post-industrial precincts, that can lead a better process of scaling up into policymakers and to the top-down implementation of holistic policies that include bottom-up and top-down definitions (Krauz, 2016) (Figure 3.6).

In this case, to create a panorama from current policies to grassroots actions regarding axes related to CE and Systemic Design. Furthermore, this phase aims at describing their main features and priorities, but at the same highlight the potentialities and criticalities from an SD and CE perspective. On this view, the analysis was divided in:

- *Top-Down:* A panorama of the current policies that in execution in the case study precinct. Focusing on policy instruments at city, regional or national level that have address regeneration topics as a multidimensional concept containing economic development, employment opportunities, services effectiveness, cultural and social regeneration and inclusion. Also, considering instruments that have influenced the case study areas over the last years such as; city Master Plans, regeneration programmes, environmental strategies, re-industrialization plans and specific funded projects that influenced the area.

- *Bottom-up:* A panorama of the organizations that are leading current grassroots actions on case study precincts delivering a state-of-the-art on the potentialities and challenges of local stakeholder interactions. Whose activities sometimes have built a more effective citizen-public administration relationships. Also, promoting local development through actions on social innovation, entrepreneurship, health, food security, and cultural heritage. Their interaction with citizens intends to act as a catalyst for initiatives that arise from the territories and facilitate the synergies of interventions -emerging, ongoing and future- that provide for the active participation of citizens in the co-design and implementation of interventions for the redevelopment and regeneration of collective spaces. In perspective, the local associations execute management of collective assets which facilitates the involvement and active participation of citizens, encouraging

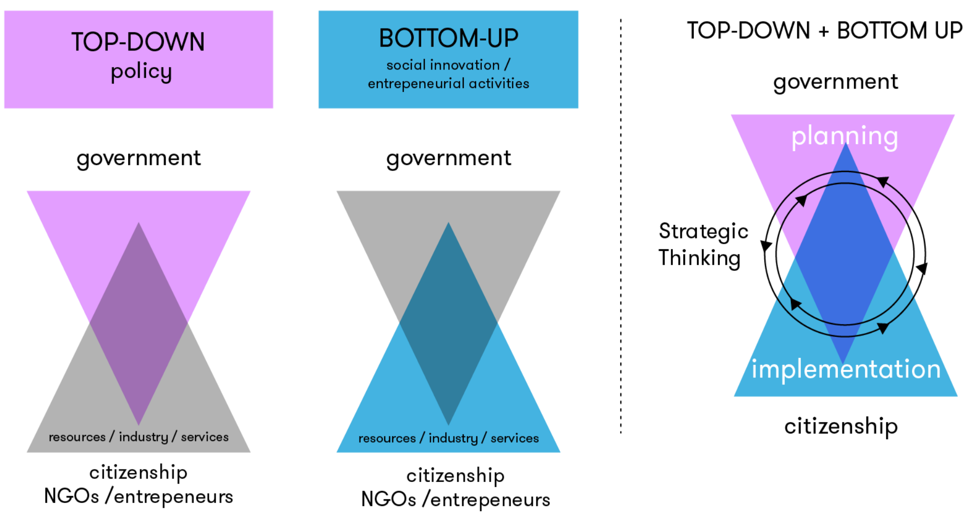


Figure 3.6 Policy Framework Analysis scheme

the inclusion of all the groups of communities involved in the process, with attention to the weaker groups.

These actions deliver a state-of-the-art highlighting the significant strengths and weaknesses of the case study precincts. Moreover, identifying the relationships generated by these local and government actions as a critical asset. This combined vision of bottom-up and top-down actions delivers an iterative horizontal dialogue and strategic thinking among stakeholders, previously discussed in section 2.4. Moreover, it demonstrates how Systemic Design could stimulate local assets towards urban resilience and foster CE.

The mapping of this policy scenario allows having a better comprehension of the role of all local actors essential for the development proposals grounded in the local context. Also, it created a multi-stakeholder dialogue which can support a CE policy transition and bottom-up process effectively.

STAKEHOLDER IDENTIFICATION

Within the Systemic Design principles, it is acknowledged that to address the increasingly globalised environmental challenges; it is required active cooperation on a quadruple helix model which implies governments, industries, communities and research institutions (Figure 3.7)(see Chapter 2). Strong synergies and cooperation on a quadruple-helix model are identified as primary conditions to build value for society and the environment. On that view, systemic perspectives and participatory methodologies - which Systemic Design combines -can trigger innovative processes of sharing knowledge and experiences among different stakeholders and can build innovation in the public sector (Jones, 2018).

For this reason, the local partner engagement process consisted of Stakeholders mapping and selection. That means that for each case study, the researcher carried out a stakeholder mapping to identify the stakeholders that can influence the transition to the CE in public administration, business, associations, education and civil society (Ferruli et al., 2019). The selection was based on a mutuality perspective,

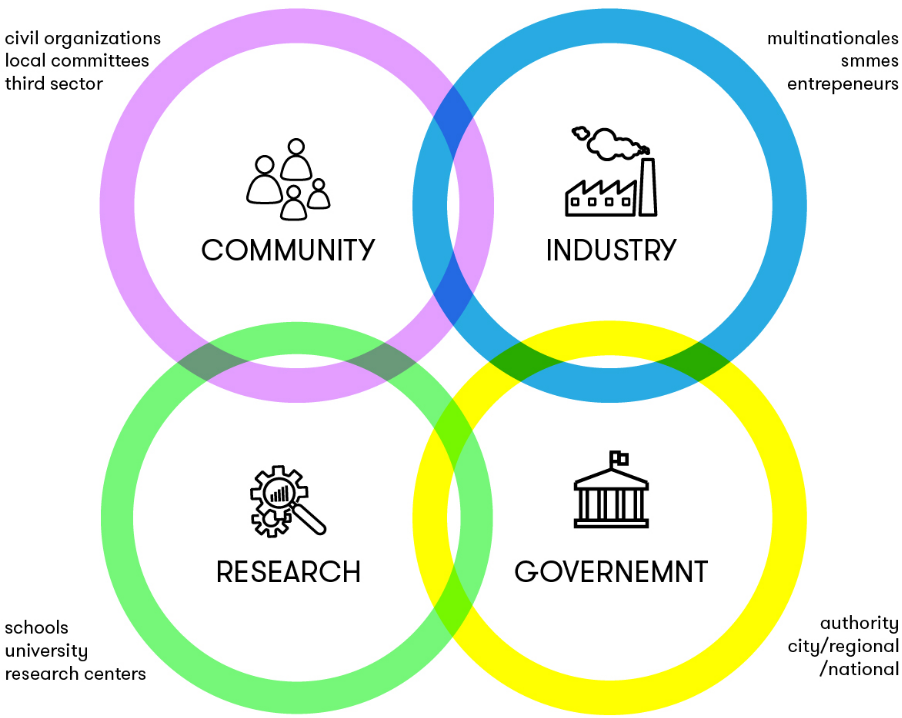


Figure 3.7 Stakeholder Identification ,

identifying the reasons why each stakeholder was important for the research project and, at the same time, the benefits stakeholders could gain from collaborating in the research project. The quadruple helix was consider in the following categories; Government, Community, Industry, Research (Figure 3.7).

For that aim, the involvement of stakeholders was essential to ensure the participatory development of an effective systems approach to the precincts. Also, this stakeholder network will later serve on the implementation, monitoring and constant feedback of the new system strategies, creation of a supportive background for the transition to the CE (Barbero, 2017). Moreover, they can help make the framework more accessible and comprehensible for transdisciplinary research toward sustainable development (see section 5.3 and 6.3).

3.9.1.2 Research and Data Collection

According to the System Design methodology for the data collection a the mixed-method approach that was adopted by this investigation, this was further explained in section 3.4 research strategy. On that scope this the research project applied was the data collection methods for the research phase (Figure 3.3) such as; desk research (quantitative method) and field research (qualitative method) (Gaiardo, 2016; Barbero, 2016), using the terminology from (Celaschi et al., 2007). The researcher approached the methods in the following way:

- *Desk research*: In the case of this research, it regarded the review of the existing data (Figure 3.3 of the state-of-the-art is accomplished through various sources, both conventional and unconventional. Conventional sources are recognised as existing scientific literature, official reports, and databases. Unconventional sources are recognised as official data found on social networks (Facebook, Twitter, Youtube, LinkedIn) and audiovisual media (T.V., News, Radio, Internet) that could be supported on verified portals. In both case studies, the accessibility of specific databases was different in some of the data categories (i.e. differences in the national census) this meant that the level of detail varied in each case study (Battistoni et al., 2019) (see Chapter 5 and 6).

- *Field research:* This type of research takes place on the site of the research for a direct collection of data. This approach involves tools and informal activities, such as interviews, observations, and vivid descriptions of qualitative and quantitative information. The analysis was executed through direct experience in the field of reference, ranging from direct data recording to collection of perceptions (pictures, direct interviews, etc.). This process required many field visits inside each case study precincts to understand its qualitative aspects, which usually were not given by the desk research (Battistoni et al., 2019). This phase also was an approach as an integration information research step (Figure 3.3) that complemented to the existing information (desk research)(see Chapter 5 and 6).

Both happened simultaneously, as they complemented one another and at the same time, it left the possibility to verify, in the field, the information found with desk research if necessary. This kind of data collection for applied in this examination usually finds its most significant shortcoming in the lack of openness and trust from the stakeholders involved to the researcher (Battistoni et al., 2019), on that case it required the signing of a non-disclosure agreement where they authorized the data processing for this research project (see Annexes I and II).

Afterwards, it is established the data collection phase (Figure 3.3) which aimed o to assemble the data gathered in the research phase. Such data was organized inside the format established in the framework assessment step (see Annexes I and II). Furthermore, it was essential to include the references for each data in order to guarantee accuracy inside the analysis and enable tracing of the information at all times. Here, the HD format becomes a vital tool to reach a synchronized dialogue between the actors of the research, allowing them to add information into the format simultaneously. This organization supported the researcher in further steps with a unified database outcome (Barbero, 2017; Battistoni et al., 2019).

3.9.1.3 System Visualization

The visualisation of the data eased the reading and interpretation of the complexity, which is considered a qualitative inductive method (Robson,2002). Allows the researcher to reframe the so-called wicked problems (Buchanan, 1992)of a territorial system, highlighting the driving factors and the sleeping assets. As a result, it intends to reach, adopt, and mirror the complexity and wickedness of real-life networks of interconnected problems (Sevaldson, 2018). On that view, the visualisation phase (Figure 3.3) aimed through a research synthesis the graphic representation of the collected data, exposing their potential correlation. Nevertheless, the interpretation of the database on a first approach can be difficult, given the complexity of each case study context. At that stage, the information and the potential connections between the categories were only comprehensible by the researcher. Therefore, this phase was vital to place the information on a common ground where all stakeholders can access it and have a productive and collaborative horizontal dialogue (Battistoni et al., 2019).

So, in order to display the information smoothly and comprehensively, it is necessary to use different graphics tools to elaborate visualisations and infographics. The display of this information allows the researcher to glimpse possible connections between the various categories relating to quantitative and qualitative data:

“Using drawings or pictures as a way of representing problems or issues is widely used for collaborative problem-solving, and the power of diagrammatic representations to evoke and record human perspectives is widely acknowledged across a range of domains including sustainable development, social entrepreneurship, information visualisation and knowledge representation”. (Berg et al., 2017)

Some scholars argue that context is essential to understand visualization, and *“graphics must not quote data out of context and context is essential for graphical integrity”* (Stabellini et al., 2017). On that perspective, on the visualization phase (Figure 3.3), the role of the designer (researcher) as a mediator between complex data and the stakeholders of each precinct case study, translating the given information into an efficient and straightforward visual language (Celaschi, 2008). So the researcher/designer in possession of the database, Policy Framework Analysis and Stakeholder Identification was able to generate infographic maps or giga-maps (Davidová, 2016). As Sevaldson (2013) suggested on relation to giga-maps;

“through stages of refinements shifting between manual and digital media...helped the designer to internalize very large amounts of information...printing it out in hard copy and hanging it on the office or studio wall would make these large amounts of information immediately accessible at any time”

Particularly, in the precincts case studies, the research synthesis acquires a central role in the management of complexity, proving to be a useful method for the researcher to control a significant quantity of data. Furthermore, the entire process turns into a platform where, on the printed giga-maps (Chapters 5 and 6), all the stakeholders can get involved, give their feedback, and have a big picture of the system during analysis (Battistoni et al., 2019).

3.9.1.4 Interpretation and levers

The interpretation phase (Figure 3.3) aimed an effective and holistic reading of the case study precincts, enabling in-depth analysis of the context by locating connections among the data presented on each infographic map. Moreover, visualization enabled the interpretation of the data’s flows, as well as relational factors, encouraging an overview of the existing relationships between the components and processes. Such interpretation oversees the system’s criticalities beyond the immediate cause but from a broader perspective of how it can be addressed from a systemic point of view (Ruttonsha, 2018). This step relates to the following step after the HD the “Definition of problems and leverages for change” (Figure 2.3) as it is possible to underline the challenges and opportunities to gather leverages for value creation, for the definition of new complex systems tailored to the territory.

The interpretation also involved the participant stakeholders who elaborate on further analysis of the complex scenario, integrating all feedback. This co-desing activity is developed in workshops,

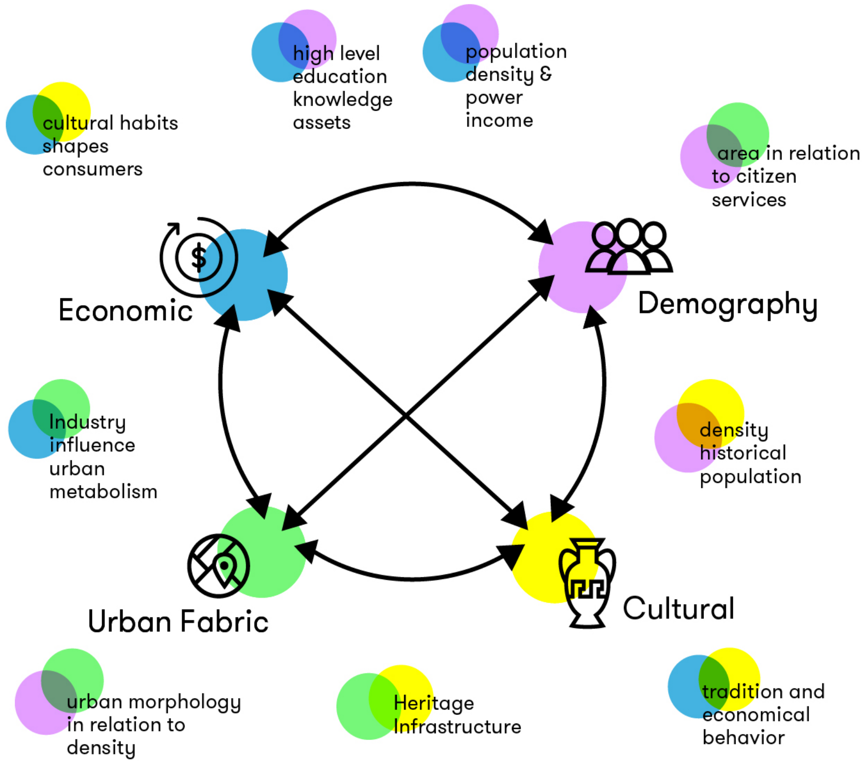


Figure 3.8. Example of interpretation and correlation of data among all categories of the data collected.

roundtables or sensemaking sessions. Ultimately this stage shows that this kind of method leaves the HD open and comprehensible to everyone, from experts in the field to everyday citizens (Barbero, 2017; Battistoni et al., 2019). An example of this interpretation of information in Figure 3.8.

Specifically, for this research project the interpretation phase (Figure 3.3) was based was executed regarding the research scope described on Chapter 4, which proposed a co-design of Circular City model for post-industrial precincts, in order to to be applied on both case studies. So the researcher carried a method of design synthesis of the visualization (Database, Policy Framework Analysis and Stakeholder Identification) identify territorial assets/potential levers that can activate the three main Circular Actions (Regenerate, Adapt, Loop) which came from the scoped Circular City model which will be explained in details in Chapter 4. This process allowed the recognition of in each case study precincts the exposing the potential of the local assets on a CE lens which included opportunities and challenges as leverages for value creation, and their data correlation, to activate a Circular City model.

3.9.2 Design a Circular City model

The re-design of the current system means a Circular City Model for each post-industrial precincts case study on a 'Time-Based Design' perspective. To achieve this, the researcher regarded the Holistic Diagnosis outcomes and the scope of the Circular City model (Chapter 4), that delivered the project methodology. Therefore, the scoping study was framed by a specific literature review targeting the evolution of the Circular City model carried to reach a theoretical proposition on Systemic Design approaches for a Circular City model, as set out in the rest of this Chapter. For that aim, the literature review from the urban sustainability background to the currents models around the Circular City (Figure 4.1). Ultimately, the researcher carried a method of design synthesis of the outcomes into a theoretical proposition to inspire a Circular City model on the lens of Systemic Design for post-industrial precincts (Figure 4.4), in order to to be applied on both case studies. This overview allowed the researcher to comprehend the systemic dynamic, meaning the Circular Actions that were more suitable to activate a systemic transition towards a Circular City Model, depending on the precinct context of each case study.

3.9.3 Assessment of research Outcomes

The research outcomes of this examination intended at addressing research objective 4, *'to evaluate the potential impact and relevance of this research project's contribution beyond its specific case studies*' (Chapter 7). Through an inductive approach of the outcomes, both cases study was proposed a discussion review the impact, relevance and transferability. This last step will be approached as an assessment of the applied Systemic Design Framework for Circular Cities (Figure 4.4) on each case study, the environmental, economic and social benefits, implies a foresight vision on the CE strategies. At the policy-making level, these results aim to influence local policies on both precincts to foster better governance and disseminate innovative solutions towards a CE. The case study application aimed to oversee the strengths and challenges of the proposed framework implementation by examining four levels of innovation:

- *On the technical level t*hrough the development of a Circular City model that could be implemented according to their Technology Readiness Level (TRL). In order to understand the requirements that each circular strategy need in order to develop new economic opportunities, products, and services which will be marketed by the public-private sector partnerships. These could result in the creation or redesign of local, circular supply chains.

- *On the social level* through co-designing, co-creating and co-implementing a Circular City model in partnership with local communities, who will be integrated into the development of targeted and participative urban regeneration plans. Such output will be measured in new protocols and standards for the integration of a Circular City model within policies which enable citizen-based ownership of local resources on post-industrial areas. These procedures will be used mainly addressed for the public sector and developers in cooperation with civil society and the private sector.

- *On the economic level* through combining systemic approaches, a Circular City model with business models for market-ready products, the output will the increment of Circular business model strategies highlighting market opportunities and public-private partnership models for circular productive activities that will reactivate the deprived urban voids. These can be used in the private sector, social entrepreneurship, and public action.

- *At a cultural level*, the Circular City model in order to be resiliently required to meet today's cultural and economic interests enhancing the precincts identity (traditions and heritage). The model not only to address the cultural system challenges through a new circular market scenario but more importantly, it delivers a long-term value creation strategy to make the precinct resilient.

This assessment aims to unveil a different overview of the given case studies opening it up to a comprehension of the multiple opportunities for innovation towards a new Circular City model of political drivers on a policy cycle decision-making. For policymakers, model and along with the Systemic Design approach can support the creation of more efficient policy cycles that can foster better governance on CE and disseminate innovative solutions to reinvent and shape more Circular Cities.

3.10 Sampling Strategy

To have a better comprehension of the chosen case studies, the researcher approached a sampling strategy. This method is the direct connection that ensures the research outcomes have validity in the real outside world. Therefore, it is necessary a strategy that determines the selected subjects for the research study - in this case, the post-industrial precincts and their stakeholders- which indeed are representative from the subject which the sample is drawn. To achieve this, the researcher selected the subjects due to their relevance (knowledge) to respond to the research questions.

On that view, due to the pragmatism nature of this research project on comprehending post-industrial precincts approach to their urban social, cultural and economic fabric, a sampling strategy was chosen (Robson,2002). This technique defined as a non-probabilistic sampling which is bases on the judgment of the researcher on identifying subjects that possess characteristics or circumstances related to the examined phenomenon, in this case, the governance of post-industrial precincts transitioning towards a Circular Economy.

To achieve such comparative and comprehensive vision of how such phenomena develop in extreme scenarios within the Global North and South. Such categories global North and South are not rigorously a geographical category but a political economy characteristic. The term Global South applies to countries ranked by the World Bank as low or middle income located in Africa, Asia, Latin America and Oceania. Other scholars refer to it as underdevelopment countries which are strongly influenced by colonialism, neo-imperialism, wide disparities in living standard and scarce access to public services. On the other hand, the Global North term refers to the regions with developed economies such as Europe, North America and Australia (López 2007; Prashad 2012; Dados & Connell, 2012).
On that view, the two samples selected for these case study research: Mirafiori South Precinct in Turin (Italy - Global North), and Atlantis precinct in Cape Town (South Africa - Global South). Both precincts represented at their time the role model of the "city factory"/industrial cluster model, presenting accelerated industrialisation and unexpected post-industrialisation processes that has been challenging to overcome. Also, both cases are considering their post-industrial legacy as a pillar for to generate a Circular City model, the samples were selected for their relevance to this criterion. Still, the nature of both scenarios (Europe/Africa) is radically different the purpose was to deliver a broader and diverse understanding on how to activate the decision-making process to transition into a Circular City model.

Furthermore, to provide the research project with academic support, both the case studies were linked to local authorities for each precinct respectively: City of Turin Department of Innovation and Smart City (Italy) and The GreenCape - government sector development agency on GreenTech WESGRO - Trade & Investment Promotion Agency for Cape Town and the Western Cape (South Africa).

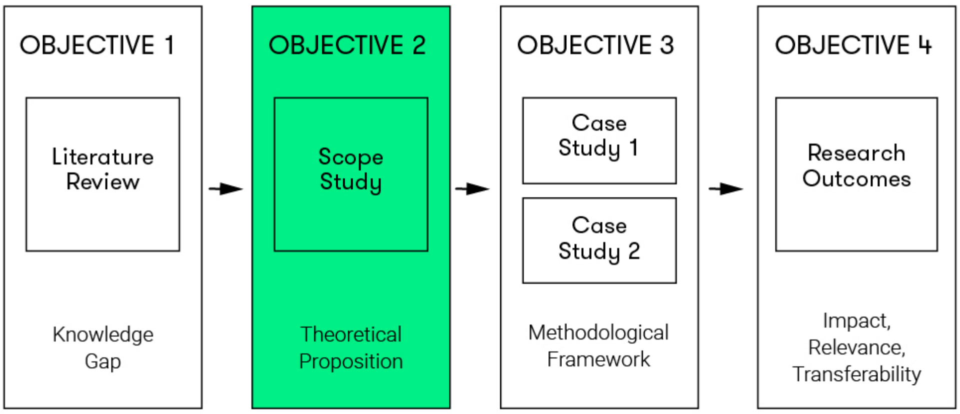
With this in mind, the first case study focused on the post-industrial precinct of Mirafiori South in Turin (Italy), born (1939) to host FIAT's - Italy's biggest car manufacturer - known as the 'automobile city'. The end of the "Fordist City" era (the 80s) came when for Mirafiori South precinct meant that without FIAT massive production, the area became a most evident space of social segregation and depraved spaces. For that reason, in the last decades, the city government focused on several regeneration projects involving urban fabric, social, economical and cultural aspects to create resilience in the precinct. Nevertheless, despite the massive amount of resources and expertise, they have always reached rather modest outcomes. Due to this long history, to the government city has targeted the precinct to be a Living Lab to experiment with circular economy strategies, this comes from the purpose to transform it on the first circular precinct of Turin. Working in a close partnership with the City officials and stakeholders (see section 5.3), the precinct examination of this research project through systemic design aimed to ease a decision making process understanding of the potential CE strategies for a resilient Circular City model on a Global North perspective (see Chapter 5).
On the other hand, the second case study was focused on the post-industrial precinct of Atlantis in Cape Town (South Africa), the most significant examples of African city-factory characterised by a relentless process of physical, economic and social degradation. The precinct was established in (1965) as part of the apartheid planning policy through a program of incentives to create the strongest Industrial Precinct and Township in Cape Town. The end of the flourishing economic era (the 80s) came when with the decline of the apartheid government which meant that without the government incentives for massive production, most companies left the area became a precinct known for social segregation, poverty, unemployment and depraved spaces. In the last decades, the government focused on several re-industrialisation projects to bring industry again and generate resilience in the livelihoods of the precinct. However, despite the government plans, they were never accomplished or reached

rather modest outcomes, that increased the high levels of frustration and lack of trust from the local population towards the government. As a response to the government has declared (2018) the area to be the first green hub of Africa a Special Greentech Economic Zone, including not only industry but all of the stakeholders and inhabitants with the purpose to transform it on the first circular precinct of Africa. For this examination, the researcher worked in a close partnership with the Government agencies and stakeholders (see section 6.3), the precinct examination of this research project through systemic design aimed to influence the decision making process on the current Master Plan for the area understanding of the potential CE strategies for a resilient Circular City model on a Global South perspective (see Chapter 6).

From a Circular City model viewpoint, the samples were chosen to present two different, yet equally representative, opportunities for Systemic Design approach for decision making (Barbero & Giraldo Nohra, 2018), seeking a localized overview of resources, exposing the potential opportunities and challenges as leverages for value creation, and their data correlation, to comprehend different perspectives (Global North and South) to activate a Circular City model.

Chapter 4

Scoping Study ‘Circular City model’



This Chapter approaches the Scoping Study intended to address research objective 2, “To develop a theoretical proposition to co-design a Circular City framework tailored to Post-industrial area”. For that purpose ,this Chapter explains research question 1 of this examination: ‘What Circular City model can be envisioned post-industrial precincts, and what are the challenges and opportunities for their transition?’

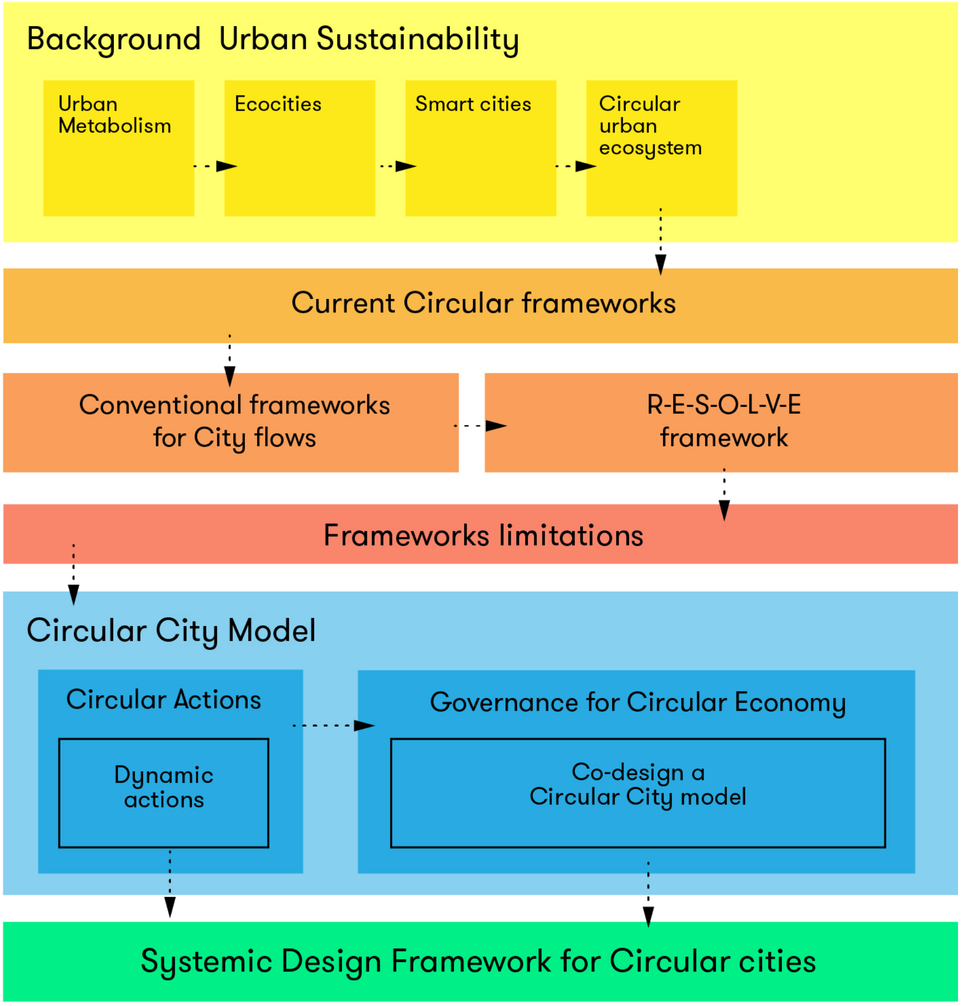


Figure 4.1 Research methodology scheme Chapter.

4.1. Introduction

This research phase was informed by the literature review that identified the wicked problems hampering the transition of post-industrial precincts towards a Circular Economy (CE). The perpetuity of this challenges overtime has resided at the decision-making processes from both top-down perspectives, where reactive decision making on development strategies has been unsustainable in terms of lack value creation on local resources from material flows, livelihoods, community networks, local economies, cultural heritage and environmental ecosystems. The literature review has identified the need for achieving a systemic transition towards a CE; however, a lack of comprehensive studies on decision-making for cities (post-industrial precincts) to achieve such circularity was highlighted.

To overcome this issue, strategies of Systemic Design were proposed from the literature; yet, these first findings require to be verified. Moreover, the challenges and opportunities for post-industrial precincts to transition towards a Circular City model need to be identified in order to scope and guide this research project.

Therefore, the scoping study was framed by a specific literature review targeting the evolution of the Circular City model carried to reach a theoretical proposition on Systemic Design approaches for a Circular City Framework, as set out in the rest of this Chapter. For that aim, the literature review from the urban sustainability background to the currents models around the Circular City (Figure 4.1). Ultimately, the researcher carried a method of design synthesis of the outcomes into a theoretical proposition to inspire a Circular City Framework on the lens of Systemic Design for post-industrial precincts, in order to to be applied on both case studies. For this aim, the latter objectives were set out for this examination:

1. To conduct a review on urban sustainability background in order to understand the trends that shaped the conception of a circular urban ecosystem;

2. To review the current circular economy frameworks and their limitations in a city context in order to understand the theoretical propositions of a Circular City model

3. To analyse the conceptualisation of Circular City model, including a review of Circular Actions and their dynamics; To understand what model of governance this must imply.

4. To develop a Systemic Design Framework for a Circular City model to establish co-design practices for post-industrial precincts.

4.2 A Circular City on the way

In order to understand the Circular City model nature, it is necessary to review in the literature the evolution of its conceptualisation. Nowadays, cities are seeking to comply with sustainability standards while their populations continue to increase. According to the United Nations, 70% of the world population will live in cities by 2050 (UN, 2018). Today, cities occupy 7% of the earth land extension, and despite the fact, cities are responsible for 80% of energy consumption, 75% of annual resource use consumption and waste production and 75% of carbon emissions (UN DESA, 2014; UNEP, 2019). From that perspective, it urges to address the role of cities as active contributors and victims to the threats of climate change such as hurricanes, floods and droughts (Parry et al., 2007; Rosenzweig et al., 2011).

The accelerated industrial development of the XX century brought the uprising of the city development around industrial clusters carrying considerable urban and economic growth, and an increasing amount of global resources consumption (Krausmann et al., 2009). Such a model of an extractive economy based on finite raw materials has evolved into our current linear economic system (Milios, 2018; Rockstrom et al., 2009; Urbinati et al., 2017). In the last decades, the 'take-make-consume-waste' approach has made cities very vulnerable to the global market behaviour, bringing tremendous environmental, economic, societal and cultural challenges from pollution, waste management, scarcity of resources, unemployment, brownfields, among others (EMF, 2012). Perpetuating the model of the wicked problem explained in Chapter 2.

As introduced in Chapter 1 is in this scenario where post-industrial precincts are framed as they are the ultimate example of where is leading the linear economy model. Such precincts proof that the current system of consumption and production trends is no longer sustainable, and without a system's transition, cities will accelerate resource scarcity and instability (O'Neill, 2009; UNEP, 2019).

Consequently, many cities are re-planning themselves and expanding into innovative approaches to face this challenge. From that view, the role of the city governments it is fundamental to lead urban sustainability issues and to tackle climate change at the city-level. Therefore, decision-makers are taking action in the field of sustainability, and CE is one of the models that is increasing momentum (Erickson & Tempest, 2014). As introduced in Chapter 1, the aim behind CE is the development of systems that overcome the current linear economic model. Defined CE since the limits of planetary resources in "Spaceship Earth" (Boulding, 1966), to the necessity for closed looped cycles (Pearce & Turner, 1990) and overview through the general systems theory (Von Bertalanffy, 1969). Over the last decade, many scholars have defined, but this examination adopted the one stated by (Korhonen., et, al. 2018) (see Chapter 1).

To understand the comprehend the application of CE ina city context is required to have a retrospective on the previous applications of the concept. In the early stages from 1970 until 1990, CE related applications were concentrated on waste management and treatment policies (i.e. cradle-to-grave policies) (Campbell-Johnston et al., 2019). Afterwards from 1990 until 2010 came the eco-efficiency concept, inside an industrial ecology approach that mirrored natural ecosystems (Ghisellini et al., 2016), influencing cradle-to-cradle policies (i.e. reusing materials)(de Jesus & Mendonça, 2018; Stahel, 2016).

Nowadays, the CE attempts a paradigm transformation to decreases the demand for raw materials in production/consumption process, in order to decouple the current economic system materially from environmental pressures (Cullen, 2017; Elia et al., 2017; Genovese et al., 2017; Lieder & Rashid, 2016). As a result, the CE supports a restorative and regenerative economy by purpose and design (EMF, 2013).

More and more, CE is being embraced by industries and governments, as the main roadmap to resource-efficiency on the fight against climate change (Ghisellini et al., 2016; Kirchherr et al., 2017). In particular, cities have been boosted to execute innovative paths towards circularity. Such an approach varies depending on cultural, economic and political, perspective towards CE, from top-down plans (Elia et al., 2017; Lieder & Rashid, 2016) to multi-stakeholder engagement (Gregson et al., 2015; Van Leeuwen et al., 2018). Hence, a first suggestion was presented in Chapter 1, delivering an overview of the CE approaches on the global north and south, that is a scope of this research project.

Today, the lead on defining and applying the CE at a city level has taken over by Asiatic and European cities. In the case of Chinese cities, the process has been addressed top-down national policies influence. Through their National Development and Reform Commission of China they have promoted CE pilots in urban areas since 2005, including 105 companies, 37 industrial parks, and 36 regions (Guo, et al., 2017; Wang, et,. al, 2018). Other cases like the Japanese government established the first CE policies that addressed waste management and recycling, applying the Basic Law for the Promotion of the Creation of a Recycling-Oriented Society in 2001 (Guo et al., 2017). At the same time, Japan was the pioneer to experiment with urban area models based on industrial symbiosis (Fusco et al.,2016). Such a model was primarily applied in other European cities, such as Dunkerque (France) Kalundborg (Denmark) (Esposito et al., 2018).

More broadly European cities approach it is framed by the European Commission's CE Package, which incorporates legislative plans to support Europe's transition towards a CE, to expand competitiveness for sustainable economic growth - which was introduced in detail in Chapter 1- (EC, 2015). Numerous European cities have delivered strategic policy plans to transition to a Circular City/city-region model. In order to do so, these cities are trying to develop a bottom-up and place-based approach, including extensive participatory processes with multi-stakeholder groups from industry to civil society (Gregson et al., 2015; Van Leeuwen et al., 2018). This narrative emerging at the city-level can be seen in the following strategies in diverse cities; Paris Circular Economy Plan (2017-2020) (Mairie de Paris, 2015), Amsterdam Circular Strategy (2020-2025)(Gemeente Amsterdam, 2020), London's Circular Economy Route Map 2017 (Waste, L., & Board, R, 2017), Circular The Hague: Transition to a Sustainable Economy 2018 (Gemeente Den Haag, 2018), Strategy for the Transition to Circular Economy in the Municipality of Maribor 2018 (Wcycle Institute Maribor, 2018), Roubaix Circular Economy Route Map 2019, among others.

On that view literature across cities transition to a CE has increased considerably, recent studies identify emerging CE models supported in case studies globally (Lindner et al., 2017; Prendeville et al., 2016; Williams 2019b; Campbell-Johnston.et, al., 2019). Other scholars have emphasised in the implementation of a Circular City model (Franco, 2017; Ghisellini et al., 2016; Lieder and Rashid, 2016; Wang et al., 2017) and quantified the impacts of circular urban strategies (Petit-Boix., et, 2018). On that regard on Chapter 2 (Table 2.3), was presented the main barriers to CE implementation which go beyond the technical aspects, and argue more profoundly about the cultural and societal aspects challenges and how these alter with context, this will serve as a point of reference for the scope of this Chapter.

4.3 Background in Urban sustainability

The continuous fluxes of urban livelihoods such as natural resources have inevitable repercussions, almost always surpassing their ecological footprint limits (Rees, 1992). On that view, since the early 1980s, city actors have to address sustainable development on a city scale (Bulkeley, 2010). As a result, that decade introduced, the notion of 'urban environmentalism', which concentrated on redeveloping urban fabric based on eco-environmental and biomimicry theories (Roseland, 1997). Additionally, it approached the regeneration of cities industrial hubs within the concept of urban metabolism schemes, which gave birth to the so-called eco-cities. According to Kennedy (2007), the concept of 'urban metabolism' considers the total amount of industrial and socio-economic activities in cities, leads to growth, production of energy, and the elimination of waste. Therefore, the urban metabolism actions have differed over the years from adapting biomimicry notions in an urban scale (Tailor Buck, 2015) to the concept of smart cities that embraces the optimisation of data through advanced technology to inform about resource performance (Dajani & Hasit, 1974; Jabareen, 2006). Other views focused on the city as an ecosystem, overviewing the implementation of a circular metabolism at different scales (Spiegelhalter & Arch, 2010).

Such concepts have shaped components of models of a Circular City; this section reviews the literature such as urban metabolisms, eco-cities, smart cities to the conception of the circular ecosystem. So it will establish a base for the scope of this research project on Circular City models for post-industrial precincts.

URBAN METABOLISM

Over the years, discussions on sustainable development shaped by theories from ecology and biological sciences. Among those, in particular, the concept of urban metabolism, suggests that activities at a city level that transform raw materials, energy, and water should be transformed into the built environment, human biomass, and waste (Decker et al., 2000). This notion of exchange processes that produce the urban environment has stimulated innovative approaches about how cities can be shaped sustainably. Still, it has been a critical tool raised objections concerning the city status quo particular social and economic systems in which some fluxes are prioritised or marginalised (Broto et al., 2012).

Over the last decades, the increase in literature on urban metabolism embodies a crossroads in the interests of academics in various backgrounds. The concept moves across disciplines, applying a comparative examination to urban metabolism inside diverse approaches such as industrial ecology, urban ecology, ecological economics, political economy and political ecology. Such studies share mutual matters, as the investigation of links among the sociotechnical system, natural systems and urban areas (Broto et al., 2012).

Wolman's study called "Metabolism of Cities" was the first demonstration of the urban metabolism concept, which represented the metabolism of a hypothetical U.S. city (Wolman, 1965)—describing from urban ecology perspective how cities processed energy or resources relative to their surroundings (Grimm et al., 2000). The city as an ecosystem was inspired by systems ecology investigations, which focused on the ecosystem as a vital part of the examination (Slocombe, 1993). Moreover as widely discussed in Chapter 2, the systems approach to the study of sociotechnical systems allows a complete interpretation of the complexity of city systems (Grimm et al., 2000; Mehmood 2010; Newman, 1999). Similar to the Systemic Design principles the approach of the city as ecosystem strived to promote a holistic comprehension of the complex relationships of urban systems by studying interactions between components attempting to find integrative solutions (Newman & Jennings 2008).

Another approach to urban metabolism was set by the Japanese architect Kisho Kurokawa in 1999, developing urban areas from a metabolic perspective were infrastructure is iterative operating through a process of regeneration and destruction, emulating natural cycles. Kurokawa (1977), emphasised that the urban design of those environments should be resilient enough to support a continuous cycle of development, transformation, and end of its components without destruction of the whole (Broto et al., 2012).

For instance, the perspective of Odum (1989) on the city as a parasite as it only consumes natural resources on their area range rather than generating its livelihoods to survive. Such characterisation enabled a holistic perception of the urban ecosystem in which all components/actors mediate with resource flows to create a resilient life system. Furthermore, the concept of the city as a parasite underlines the problematic nature of the system's inputs and outputs, where the consumption and production are aligned towards "linear metabolism" (Girardet, 1999).

On the contrary, the natural ecosystems - where cities are based- must be overviewed as cyclical in their utilisation of resources and energy (Dunn & Steinemann, 1998). Consequently, this will influence the long-term sustainability of cities is reliant on the change of their current metabolism from a linear to a circular model where its outputs are recycled back into the system to become inputs (Girardet, 2008).

Regarding the systems approach presented in Chapter 2, on the lens of complex systems theory, the urban ecosystems support interlinked subsystems that are in an iterative interaction between them. On that view, the urban metabolism oversees the city as a dynamic, complex, and adaptive system that combines sociotechnical ecological systems (Alberti 2008; Grimm et al., 2000).

ECO-CITIES

From an urban metabolism background, the "Eco-cities" concept was introduced in the United States and aimed to create cities addressing ecological principles (Roseland, 1997). This model focuses on urban responses to climate change implemented through particular urban "experiments" that articulate the mitigation and adaptation to climate change effects (Bulkeley & Castán Broto, 2013; Evans 2011; Rapoport 2014). Therefore, cities are overviewed as experimental hubs in which innovative technologies, architectures, and environmental-economic policy are combined into a utopian green approach to the city as a laboratory—presenting the city's urban fabric as a single site of intervention, in order to propose an urban metabolism-based only on socio-economic, environmental, and technological associations (Caprotti, 2014). This approach narrows the city is to an experimental site on which green technologies and strategies can experiment to spread them across broader scales afterwards (Scrase & Smith 2009; Shove & Walker, 2007). From that perspective, Eco-cities as urban laboratories for green technologies are also addressed as important hubs to experiment economic-environmental policies within a city and peri-urban perspective towards a "low carbon" economy (Williams, 2013).

Such phenomena can be witnessed through the bursting amount of eco-cities being developed, planned and built around the world as; the eco-island in San Francisco Bay (Joss 2011), solar-powered eco-cities such as Masdar, Abu Dhabi (Caprotti & Romanowicz 2013; Cugurullo, 2013), "sustainable city" Lavasa, India (Datta, 2012), and 100 eco-city plans across China (Wu, 2012). Many of today's Eco-cities are planned around major urban economic-environmental development master plans. In the last decades, the special economic zones (SEZs) are the most common approach to build new eco-cities where it is aimed a transition towards a green economy (i.e. Masdar city was built within a new SEZ)(Caprotti,2014).

Furthermore, there are significant challenges correlated with the development of Eco-cities. Some scholars argue this sites can turn into "green capitalism" or emerald islands" with no generation of sustainable development of local value but rather promoting "industrial capitalism as usual". As a result, this phenomena could increase environmental and economic disparities in their geographical sites (Huber, 2008).

On that lens, the Eco-cities require to reconsider the participation and planning mechanisms within they are built and governed. Although this urban environmentalism phenomenon has witnessed some achievements, still it depends on a top-down approach that requires massive incentives and investors subsidies and not addressing all parties and sectors of the city as a whole (Van Berkel et al., 2009).

SMART-CITIES

On the last decades, another influential notion of urban sustainability has been the so-called “smart cities” (Bakıcı et al., 2013; Cocchia, 2014; Caragliu et al., 2011; Hollands, 2008). This concept was first described in the early 90s by the Smart Growth Movement (Harrison & Donnelly, 2011). Afterwards, further discussions around innovative technology-based solutions applied in urban environments to increase intelligent city development and sustainable socio-economic growth (Alawadhi et al., 2012; Dirk et al., 2009; Nam & Pardo, 2011; Nijaki & Worrel, 2012).

On that view, Smart Cities are recognised by the widespread application of Information and Communication Technologies (ICT) solutions, in different metropolitan areas, in order to support cities gain better performance of their resources. The existing literature on Smart cities suggests that ICT systems have a central role in the city planning, as they represent the city digital nervous systems which gather data from different sources (e.i. drains, parking spaces, security cameras, public institution thermostats, traffic lights)(Nerotti. et al., 2014). To that aim, it is required the use of sensors, wireless technologies and software solutions to manage “big data” (McKinsey Global Institute, 2011; McAfee & Brynjolfsson, 2012). On that view, they embrace sophisticated systems that are monitoring the significant amount of real-time data which is processed through various institutions to optimise services and notify city authorities on developing challenges or incidents (Hall et al., 2000; Marsa-Maestre et al., 2008).

Nevertheless, this must not presume that a higher coverage of ICT systems or the amount of “smart” strategies supported by a municipality is not an indicator of better city performance. The ICT systems are considered as a mediator interface that can deliver preliminary results about the work required to increase the quality of life in an urban area improving sustainable productivity (i.e. urban metabolism approach) to inform managing authorities and decision-makers in cities (Neirotti et al., 2014). As a result, technology combined with human and organisational capital develops efficient social, environmental and economic policy decisions for an urban ecosystem (Caragliu et al., 2009; Correia & Wünstel, 2011; Giffinger et al., 2007; Hollands, 2008; Toppeta, 2010).

From an urban planning perspective, Smart Cities allows a combined approach to metropolitan operation processes. Such focus on production and the distribution of resources (i.e. waster, waste, energy, transportation). In these settings, an improvement in sustainability relies on the deployment of ICT systems, along with the introduction of appropriate policy interventions and urban planning (Neirotti et al., 2014).

Still, the notion of Smart City is widely criticised for adopting ICT strategies reactively, disregarding the effect on citizenship on a socio-environmental level (Neirotti et al., 2014). Additionally, in the last years, governments and citizens have raised the matter of data protection and the ethical issue of data management for citizenship welfare

From an urban circularity perspective, Smart Cities are a significant enabler of CE initiatives (Nobre & Tavares, 2017). They have been crucial for the digitalisation of the urban environment reflected the vast number of online services, and the behaviour changes they entail, which imply environmental effects (Anthopoulos & Vakali, 2012).

CIRCULAR URBAN ECOSYSTEMS

After reviewing the path of urban sustainability the Circular City is the latest iteration, enhancing local value creation perspective to of urban metabolism (Kalmykova et al., 2015; Kennedy et al., 2011; Ribic et al., 2017) combining and redesigning infrastructure, services, enterprises, and the socio-technical system through (Milios, 2018; Mirata & Emtairah, 2005; Zhijun & Nailing, 2007). Such perspective regards that CE strategies in order to be resilient and effective, require a systems transition approach that must be regarded from a multilevel perspective. The implementation of such “circular ecosystem could be summarized at three levels: micro (consumer level), intermediate (industry) and macro (nations, regions and cities)(Ghisellini et al., 2015). Next, in this section, we will explain each of the levels that the transition to a circular ecosystem requires.

The first level of CE implementation ecosystem relates to the citizenship to a consumer or “micro” level. Today, the effects of globalization at a local scale are highly influenced by consumer behaviour, and green public procurement, the support of consumers responsibility is essential the acquisition eco-friendly goods and services (Geng & Doberstein, 2008; Su et al., 2013). Furthermore, the previous must be supported by waste management strategies that promote the recovery of resources for environmental impact prevention, in order to avoid predominant practices of disposal landfilling or incinerating (Ghisellini et al., 2015).

The following level to implement a circular ecosystem will be the “intermediate” the refers to industry and production of goods. This scale approaches the production side regarding the application of CE strategies such as ecodesign and cleaner production actions (Ghisellini et al., 2015). Nowadays, cleaner production is acknowledged as a fundamental strategy for sustainable development (Van Berkel, 2000) as it proposes cleaner products, processes and services with a considerable decoupling of waste and emissions (Van Berkel, 2007; Frondel et al., 2004; Gwehenberger, 2003; UNEP, 2019). This intermediate-level also implies the integration of eco-industrial parks and industrial symbiosis districts (Yuan et al., 2006; Chertow & Ehrenfeld, 2012; Su et al., 2013). This industrial symbiosis approach requires material resource trade-offs between various organizations, companies or institutions (Chertow & Ehrenfeld, 2012). Such models are based on the “urban metabolism” and eco-cities perspective discussed in the previous sections.

The last layer of transition on a Circular Ecosystem is the macro level which involves nations, regions and cities (Ghisellini et al., 2015). This level summarizes the components of the previous two levels as it shall approach the circular transition in four essential aspects such as; the industrial system (level intermediate, the infrastructure system delivering services (urban metabolism on raw materials, waste and water management and clean energy sources), the socio-technical system (consumer and citizen responsibility, micro-level) and cultural framework (Mirata & Emtairah, 2005).

Lastly, in order to implement in cities a Circular Ecosystem successfully, it is essential to assess continuously across all levels the development of strategies and policies within a bottom-up and top-down analysis, in order to understand the effects that such system transition imply. Such rigour is necessary in order to would provide feedback information for decision-makers shaping the next Circular City.

4.4 Current Circular frameworks

Given the growing interest of academia, industry and governments on applying circularity at various levels, several CE frameworks have been developed over the years. Among the earliest come from the industrial ecology point of view, scholars had studied the frameworks of the Material Flow Analysis (MFA) and Life Cycle Assessment (LCA) on reconfiguring the metabolism and decoupling the impact of production in industries (Kennedy et al. 2011; Bai 2007; Kennedy et al. 2007; Schulz 2007). Among other approaches is the cradle-to-cradle framework, which outlines five principles; material health, material reuse, energy assessment, water consumption and social responsibility (Braungart & McDonough, 2009).

Furthermore, the framework proposed by Stahel (2010), which is centred in a service-economy dynamic that focuses on sell goods as services and optimisation of goods through renting or sharing practices. Last but not least one Ellen Macarthur Foundation (EMF) has one of the most recognised approaches with the ‘Butterfly Model’ (Figure 4.2.) which it is based on cradle-to-cradle principles, represents a bio-cycle and a techno-cycle, with a range of loops and cascades of materials flow among actors in the resource cycle (EMF, 2013). Still, these frameworks are conceptual and oversimplified representations of product value chain perspective.

Nevertheless, some of these approaches to have been applied at a City level. On that view, in the following section will be examined the commonly employed Circular frameworks in cities which are the MFA and LCA framework city metabolism and the EMF

ReSOLVE framework illustrates how a CE could be applied in a for the management of resources in cities, through six business actions: Regenerate, Share, Optimise, Loop, Virtualise and Exchange (EMF, 2015). Afterwards, the examination will approach it's the limitations of this framework on the built environment.

4.4.1 Conventional frameworks for City flows

Initial approaches on assessing urban sustainability issues (e.i., energy, mobility, urban planning, food) focused the methodological development integrated schemes that combine life cycle tools that support in the assessment of urban complexity. As mentioned on the urban metabolism section, the industrial ecology has provided critical contributions on methods for quantifying the flows of material and energy flows (Barles, 2010). Such as the MFA, which examines social metabolism through the regular evaluation of the flows of resources within a defined system, linking various sources of components, underlines the linear nature of urban metabolisms as a critical cause of vulnerability (Brunner, 2007; Dunn & Steinemann, 1998)

Several scholars have studied the MFA approach into cities (Kennedy et al., 2011; Bai 2007; Kennedy et al. 2007; Schulz, 2007), focusing the systematic documentation of all matter flows to and from an urban area can represent the various connections within urban systems and their environment (Minx et al. 2011). These quantitative examinations on city flows have supported the use of urban metabolism as a framework for urban policy (Baccini 1997; Barles 2009; Codoban & Kennedy 2008; Kennedy et al., 2007; Niza et al., 2009). The application of MFA to cities, however, has been limited by methodological difficulties, such as capturing urban areas as well-defined, bounded systems, and the lack of data at the city level (Kennedy et al., 2007; Minx et al., 2011).

Although, MFA is targeted for the qualitative and quantitative assessment of material flows but explicitly does not include environmental assessment. On that view, the MFA has complemented a quantitative method to assess sustainability at various levels such as the LCA(ISO 14040:2006, n.d.) to quantify the environmental and economic effects of a product system from raw material acquisition to end of life, performing a quantitative evaluation of the environmental impacts.

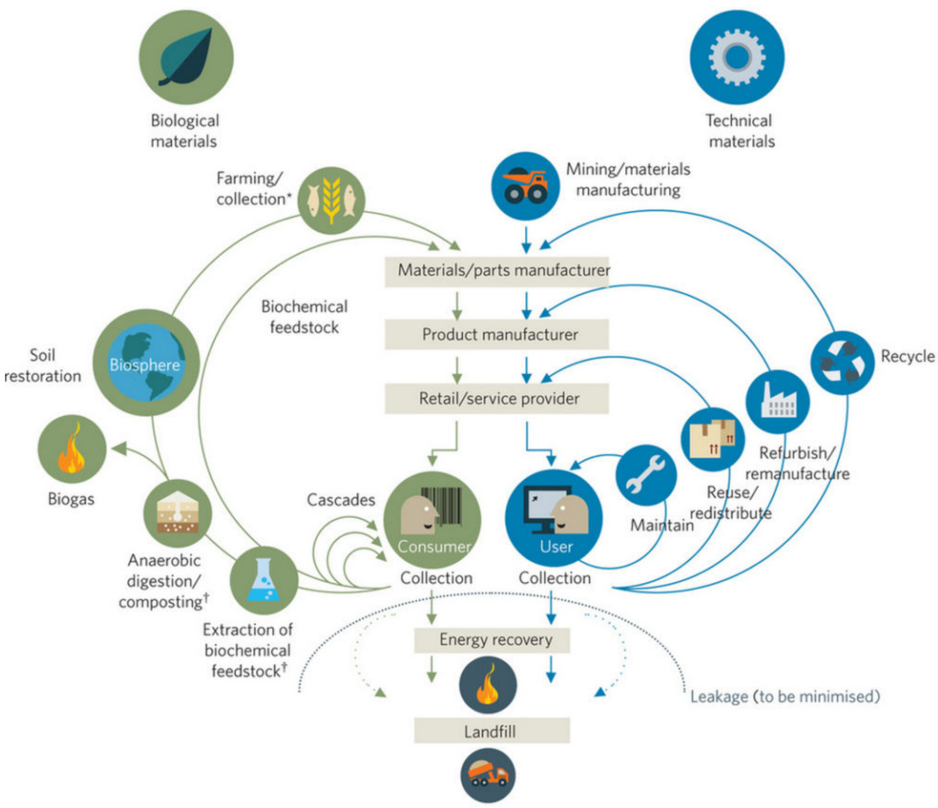


Figure 4.2. Butterfly Model – framework for a circular economy (EMF,2015).

In an urban environment lens, LCA has been one of the most common practices, as it is a refined instrument that examines the life-cycle stages of materials and products in a system in order to identify environmental challenges (Petit-Boix et al., 2017). Furthermore, the application of LCA has been reinforced through numerous policy action strategies, which involve ecolabels and eco-innovation plans (EC, 2010).

Nevertheless, studies literature suggest that LCA studies city level, require a further examination on regards significant difficulties with the representation of outcomes in order to diagnose effectively to identify environmental impacts of territorial management (Macombe et al., 2013). Also, an assessment of the LCA at city level should include more substantial participation from stakeholders which could optimize the awareness of life cycle outcomes for policy-making processes (Petit-Boix et al., 2017). This kind of framework applied to models previously mentioned from smart cities to eco-cities. Have created top-down narrative top-down among urban ecologists and urban planners to introduce circular strategies.

4.4.2 The R.E.S.O.L.V.E framework

Following the 'Butterfly Model' (Figure 4.2), the EMF describes several fields of application for transitioning towards a CE based on three fundamental principles:

- *Conservation and improvement of natural capital* by regulating limited resources and supporting renewable resource flows.
- *Optimization of resource performance* by circulating employing goods, components and materials at their highest utility level in considering the technical and biological cycles simultaneously;
- *Promoting system effectiveness* by exposing and designing out negative externalities associated with stock management and conceptualizes how these work in synchrony to accomplish a CE.

Based on that, the EMF developed the RESOLVE CE framework, which translates these three principles into six concrete business actions; Regenerate, Share, Optimize, Loop, Virtualize and Exchange. On the following (Table 4.1) it is examined a further description of the business activities, implementation examples and literature references.

Given the broad network of dissemination that the EMF has the RESOLVE is the most popular CE framework for businesses (EMF et al., 2015). Therefore, in terms of scale-up, the concept of circularity into cities, this framework offers management tools for city resources. This approach has been approached by Prenderville et al. 2018, who built on the principles RESOLVE framework, adjusting it to incorporate urban actions rather than business actions—developing on each of the six ReSOLVE strategies to create a group of Circular City principles.Still, the RESOLVE framework does have remarkable weaknesses when implemented in cities as it more narrowed towards businesses strategies instead of precise urban resource management solutions (Williams, 2017).

4.4.3 Current Circular framework limitations

One of the most significant limitations to assess the urban environment under CE is that most of the present CE literature has predominantly addressed on micro-level interventions (e.g. circular product design)(Bocken et al., 2015) and much less macro-level actions (Brennan et al., 2015).

The overview of previous approaches, it emphasises the needed to generate Circular City models that analyse the connections between metabolic flows, infrastructure, environmental, economic, social and cultural drivers (Pomponi & Moncaster., 2016; Minx et al., 2011; Newman 1999). Such an approach must be embedded in the design and governance of urban areas, introducing a view of the city as a complete system (Suzuki et al., 2009). This resemblance to biological systems requires the employment of a systems outlook when conducting a Circular City model examination.

The main limitation of the frameworks approached is that they are conceived to deliver circular strategies predominantly in industrial sectors, narrowing the focus towards physical resource flows which indicates an ambition for resource efficiency instead

ACTION	DEFINITION	IMPLEMENTATIONS	LITERAURE REFERENCES
Regenerate	Regenerate the natural ecosystems and supporting the flow of recovered biological resources into biosphere; move towards renewable energy and materials.	-Renewable Energy: Solar Panels, Wind Mills, -Renewable Materials: Biomaterials -Restore Ecosystems; Nature Based Solutions	Braungart & McDonough (2009); Bocken et al. (2014)
Share	Hold goods loop activity below and extend the life cycle of products through sharing practices.	-Sharing activities from civic commons to private property -Reuse and secondhand market	Cohen & Munoz (2016); Schaltegger et al. (2016) Bocken et al. (2014)
Optimise	Enhance the efficiency of goods/ products; eliminate waste in production and supply chain; supporting the implementation of big data.	-Design for lengthen product/ material, increase maintenance and upgrade capacity and performance. -Decouple os the supply chain to reduce waste. -Support automation and smart technologies for/big data management.	Prendeville et al. (2016); Stahel, 2010; Peck et al., (2015), Bocken et al. (2014) , Stahel (2010)
Loop	Hold materials in closed loops with practices such as; reuse, recycle, recover, remanufacture.	-Loop of materials/goods to produce by-products or energy, through remanufacturing and recycling practices.	von Weizsacker et al. (1997) Stahel (1982), Mohan et al. (2016)
Virtualise	Decouple of resources by the implementation of services (virtual platforms).	-Decoupling of traditional material goods (books, CDs, DVDs,) -A platform of services from travel to mobility.	von Weizsacker et al. (1997); Druckman & Jackson (2010); Meadows et al. (2004)
Exchange	Substitute goods/services for lower resource/energy consuming alternatives.	-Substitution traditional with renewable supplies -Implement innovative technologies to decouple production technologies (e.i. 3D-printing).	Lacy & Rutqvist (2015), Ford & Despeisse (2016)

Table 4.1. RESOLVE – framework for a circular economy . Inspired by Prendeville et al., 2018

of environmental preservation (Prendeville et al., 2014). As a result, they are addressed towards ecological optimisation of the economic system without considering the urban system.

These frameworks lack the perspective that Cities are complex urban systems. As described before, first approaches on urban sustainability represent cities as complex organisms which metabolise resources (Kennedy et al., 2007; Wolman, 1965), defining cities as a heterotrophic artificial ecosystem (Odum, 1983).

Furthermore, the city ecosystem includes composed of a complex network of stakeholders (industry, community, institutions) within resources flow; this means that the range of operating actors in a city scenario is more extensive than in a single industrial sector (Lenhart et al., 2015). In particular, most frameworks avoid the resource flows' scale - local and global - which is crucial for decoupling the cities ecosystem (Orr, 1992; Pomponi & Moncaster,2016).

In order to have a broader understanding of the complexity that implies to apply a circular model in a built environment, this examination will divide into the analysis in the following categories; urban fabric, societal, economic and cultural.

URBAN FABRIC

On regards, the complexity of the urban fabric the previous frameworks disregard the infrastructure assets, which are the principal resource – water, energy, goods - driver in cities (Allenby & Chester, 2018). The strategic integration of infrastructure in an urban system could allow circular flows of goods across sectors, supporting the decoupling of resource flow - waste stream- in cities (Jonsson, 2000). Hence, a Circular City framework should serve strategies to unlock those streams from an infrastructure perspective.

Today most cities are experiencing an infrastructure crisis; in fact, the most vivid example of that is the subject of this investigation post-industrial precincts. Most of these deprived areas are the result of infrastructural segregation boosted factors such as global markets, regulatory frameworks and institutional barriers, rendering infrastructure obsolete or under-utilised, which reinforces the linear resource flow the system. As a result, it has prevented these areas from instal a resilient circular resource systems (Williams, 2013).

Moreover, infrastructure on an urban mining perspective (Cossu & Williams, 2015) evidence this physical asset represents a considerable amount of materials, components and structures. On a global scale, construction assets represent 50% of the total raw materials consumed per year (Giesekam et al., 2014; Ness et al., 2015; Purnell, 2013). On the other hand, the renewal of infrastructure also has considerable waste implications because of the demolition, which makes even more wicked the repurpose of the land.

Therefore the adaptation, re-use and recycling of infrastructure must be at the forefront of a Circular City model (Iacovidou & Purnell, 2016). In order to support those strategies, it necessary a transdisciplinary approach to policy and urban planning across the lifecycle of infrastructure (Chester & Allenby, 2018).

ECONOMIC

Firstly is vital to acknowledge that the economy of a city is a complex and dynamic system, composed of various relationships between citizens, industry, institutions and their environment. The limitation of the present frameworks is the simplistic approach to the current challenges as they arise from fundamental characteristics and structures. The role of a Circular framework cannot just be only to fix city challenges on circularity as the previous orthodox models would prescribe. It must also be to actively shape and create a circular economic model for the city that drive more resilient forms of economic growth—intending that a Circular City model should go towards a value creation scope which is a collective process that involves all components in the system. However, it is acknowledged that frameworks such as RESOLVE and the literature have delivered a broad frame of circular business model to be applied in different scales, they are conceived in silos, not as an integrative system that creates local value.

On that view, the first asset that should be regarded as "land" which is neglected in this previous frameworks and yet is the most valuable resource in cities. Today vacant land in cities faces many challenges from speculation to brownfields management is a significant waste of a valuable resource (Williams, 2019b).

So as land provides ecosystem services which are crucial for regenerative processes in cities (Costanza et al., 1997), strategies such as recycle reuse or adaptability of land must be included in a city to optimise resource use to generate a local economy. The land regarded as a critical element to unlocking a local CE can deliver opportunities for new local (low-value) activities from urban farming to local entrepreneurial activities are likely to support the reactivation the urban ecosystem and ignite the creation of local value.

DEMOGRAPHY

In nature, a city's circular model must have the capability to involve an enormous diversity of city actors (Prendeville et al., 2018). Having that in mind, most of the previous models consider resource efficiency measures in isolation, this approach neglects the complexities of the scenario and their actors. Mostly these frameworks address production and not consumption; still, cities are hubs of both they require the same level of importance. On the one hand, in the current frameworks, consumer behaviour is scarcely understood (Hobson & Lynch, 2016), meaning that circular strategies can not switch consumption habits in cities actors which is essential for resource decoupling (Zaman & Lehmann, 2011).

At the same time, circular strategies on production should have the same relevance when regarding resource management in Circular Cities. However, the current approach disregards the complexity of urban systems of the supply chain through a broad spectrum of actors, or it is dynamics with the different lifestyles. Moreover, a Circular City model must consider that cities demography continually changes and that those social practices shape supply changes for production and consumptions.

CULTURAL

Lastly, from a local culture perspective, a Circular City model requires to support for self-sufficiency culture for production and consumption, suggesting the habits of the citizens should include awareness in the local culture, and its ecological optimisation (Rosales, 2017). On regards, the presented circular frameworks do not address the influence of local culture and its relation to the supply chain scale at which resources circulate (precincts, cities, regions, country, international). The increasing amount of global chain supplies does not stimulate the local flow of resources; on the contrary, it brings more sustainable value chains into the city that does not create local value. On that perspective, the localisation of resource flows is crucial for decoupling resource consumption in cities as it considerably decreases the resources employed and the emissions generated.

4.5 Circular City model

After reviewing the limitation of the most known circular frameworks applied to cites RESOLVE and MFA frameworks, also considering others identified in the literature (Lieder & Rashid, 2016; Braungart and McDonough, 2009; Stahel, 2010; Bocken et al., 2015). In terms of strategies to supporting the circular flow of resources, such frameworks include most options. Still, they are primarily conceptual and have significant gaps in transferability capacity into an urban ecosystem.

The vision of a Circular City model approaches cities as dynamic and adaptive ecosystems, which evolve continuously with its environment (Gunderson, 2000). Therefore, there are three considerations that a Circular City framework must approach – consumption, scale and complexity –. Consequently, to bridge this gap, this examination found among the few works of literature addressing this topic; the Circular City framework proposed by J. Williams (2019a).

The Circular City conceptualisation proposed by Williams (2019a), sets the same importance on the regeneration of the social, environmental and economic systems that converge in a city. This approach acknowledges the intersection of a broad spectrum of value chains such as lifestyles, social-ecological processes, supply chains, production and consumption patterns (Williams, 2019b).

Moreover, this holistic conceptualisation includes the reuse and recycling of each city resource such as waste, land, materials, infrastructure, water and energy, at the same time considering the regeneration of the natural ecosystem cycles in an urban system. Additionally introduces the adaptation concept of urban fabric and communities improving resilience within the city’s evolving needs. Lastly, it connects resource looping, with ecological regeneration and urban adaptation, which decreasing the depletion of finite resources and preserve a zero-waste Circular City model (Williams, 2019a).

4.5.1 Circular Actions

The complexity of the cities relies on the nature of their heterotrophic artificial ecosystem, which is based on the consumption and production of materials, water, energy, land and infrastructure by a series of city activities (i.e. manufacturing, construction, leisure, education) over various sectors and scales. In order to achieve the aims of this conceptualisation, two sets of city actions where established (Williams, 2019a);

- *Main Circular Actions:* The three core actions to the delivery circular processes: looping, regenerating and adapting. (Table 4.2)

- *Supporting Actions:* The four actions can be used to reinforce these Circular Actions; optimisation, substitution, localisation and sharing.(Table 4.3)

ACTIONS DYNAMICS

The dynamics of these actions proposed by Williams (2019a) draws a conceptualisation of the synchronised operation by the actions, in order to achieve a Circular City model (Figure 4.3). For that aim, the framework is focused first on the three main Circular Actions; Looping, Regenerating and Adapting, which support the resource cycling processes in cities from natural to synthetic, allowing the urban ecosystem restoration and decoupling the resource consumption and waste.

For instance, increasing the regeneration actions in an urban ecosystem will allow adapting to climate change or resource deficits through the support of natural capital and re-use of greywater and deprived land. Looping resources will decrease the stress on ecosystem services, and it can support the regeneration of cities ecologically. Furthermore, increasing adaptive capacity between citizenship, industry and institutions could enhance their commitment towards local looping resource actions and regenerating actions (Williams, 2019b).

ACTION	DEFINITION	IMPLEMENTATIONS	LITERAURE REFERENCES
Regenerate	Define by the capacity to address challenges such as flooding, pollution, decreasing biodiversity and soil degradation, through the recovery and support of natural capital to enhance ecosystem services. These can generate energy, food sources, climate regulation, air and water purification. Provide a wide range of benefits as decreasing air, water and pollution also enhance massively on the livelihoods and health of the citizens.	-The implementation of green and blue infrastructure such as; aquaponics,pollinator corridors, green roofs, urban farms and urban forestry. -Replace grey-infrastructure with Blue-green infrastructure.	Costanza. et al., 1997; Demuzere et al., 2014: Chaparro., et al., 2009; Maas. et al., 2006; Stigsdotter. et al.,2010; Triguero-Mas. et al .,2015; Williams, 2019, Braungart & McDonough 2009; Bocken et al. 2014.
Adapt	Define by the capacity of urban ecosystems to adapt, through the use of flexible infrastructure and urban form to support the development of the evolving dynamic of environments, decreasing the amount of resources consumed and wasted . In a city context, this action requires planning for adaptation and renewal of existing infrastructure. For that aims, it involves the emergence of innovative structures and organisation models within an urban system, which come from the cooperation between local actors .	-Implementation of flexible buildings, modular systems and temporary spaces. -Promote adapting capacities among the community through community gatherings, existing social channels, participatory apps, among others. -Implement scalable systems such as community energy and water systems. -Retrofitting on existing infrastructure, to decouple energy consumption.	Gunderson, 2000; Rauws et al., 2016: EMF,2015; Madanipour, 2018; Nemeth. et al., 2014; Bishop. et al., 2012)
Loop	Define by the capacity to utilise the waste from one city activity as a resource for another, decreasing the resource waste by closing resource loops through strategies; reuse, recycling, and energy recovery. . Looping actions supporting resource decoupling, which decreases local emissions, improving the quality of life in the urban environment and preserving the global ecosystem. Moreover, they improve the efficiency of manufacturing activities, which generates economic gains. Additionally, they provide a variety of new economic opportunities (job creation), promoting the development and diversification of the local economy .	- Waste outputs from industrial and construction value chains are reused, or recycled by industrial symbiosis or urban mining. -Abandoned infrastructure reused or recycled. -Recycle contaminated soil from brownfields to be reused on new productive activities. -Recycle of greywater and rainwater within city infrastructure, producing new circular value chains. -Support community-based actions such as repair cafes, tool-libraries and local exchange platforms, farming and second-hand markets.	Bolund., et al., 1999; Williams, 2017; Wijkman & Skånberg, 2015; WRAP, 2015; von Weizsacker et al., 1997; Stahel, 1982: Mohan et al., 2016.

Table 4.2 Main Circular Actions looping, regenerating and adapting. Source; Author

Table 4.3 Supporting Actions: optimisation, substitution, localisation and sharing. Source; Author

ACTION	DEFINITION	IMPLEMENTATIONS	LITERAURE REFERENCES
Optimise	Define by the capacity to optimise the consumption and production of resources through the adoption of efficient value chains (i.e. local supply chains, local production systems , consumer/ community sustainable habits), to decouple material and energy fluxes the in the urban system. Such implementation is possible with the application of efficient technologies and processes .	Technologies or strategies that optimise energy consumption from industrial /households operations (critical reduction of emissions), such as smart grid and decentralised energy Decouple of resource consumption in cities to decrease waste resources that will require to be looped or adapted. On an urban planning perspective, it requires the implementation of high density, mixed-use development, smart buildings and zero-carbon buildings	Prendeville et al. 2015; Stahel, 2010; Peck et al., 2015; Bocken et al. 2014; Stahel 2010; Williams, 2019.4.
Share	Define by the capacity to share or exchange resources in cities across a range of activities from local livelihoods to city infrastructure goods, to decouple resource consumption and waste production. Such practices enhance social capital, increase public engagement and the regenerative and adaptive capability of communities	Implementing sharing services for from housing, working and commuting such as co-housing, co-working spaces, tool-libraries, car-sharing platforms, bike-sharing public transport.	Cohen & Munoz 2016; Schaltegger et al. 201; Bocken et al. 2014; Williams, 2019
Substitution	Define by the capacity to replace resources, services and infrastructure for renewable choices to decouple the consumption of resources in citie	Resource-based activities substituted with service-based activities from renewable energy to service platform for commuting.	Lacy & Rutqvist 2015; Ford & Despeisse 2016; Williams, 2019.
Localise	Define by the capacity to localise of resource flows in city activities to decrease energy utilised emissions produced and resource decoupling. This action delimits the effects of consumption and promotes sustainable behaviours between the local population, industry and institution	For instance, localisation of resource flows allows establishing local symbiotic capital required to promote sustainable good-practices needed for looping, adapting and regeneration actions.	Williams, 2019.

Still, the three main Circular Actions can be enhanced through the supporting actions. Such actions contribute to the decrease of produced resources by city activities, improving the viability of implementing Circular Actions. For instance, the localisation of resource flows can allow the creation of local symbiotic capital which can optimise the current system resources—required to support eco-friendly behaviours that enhance looping and regeneration actions. Consequently, resources are effectively employed by the urban ecosystem, at the same time creating new local production streams, strengthening local value chains in the city. Moreover, the supporting actions can control the amount and nature of resources employed by the city ecosystem (Williams, 2019a).

On that perspective, the seven actions proposed by William's (2019) are conceived to be complementary and to work in synchrony in various combinations that will be determined by the given urban context. Nevertheless, the dynamics and implementation of each action will depend on the particular challenges each city faces. For instance, the most common city challenges rely on the flows of resources utilised and wasted, the status of natural capital or urban ecosystem, the necessity to adapt existing land or infrastructure, struggling cooperation culture between the community, industry and institutions. These indicators will determine the adopted actions for a city to implement a Circular City model. Still, the main goals of a Circular City model will continue to be the same; regeneration and renewal of complex urban ecosystems (Williams, 2019b).

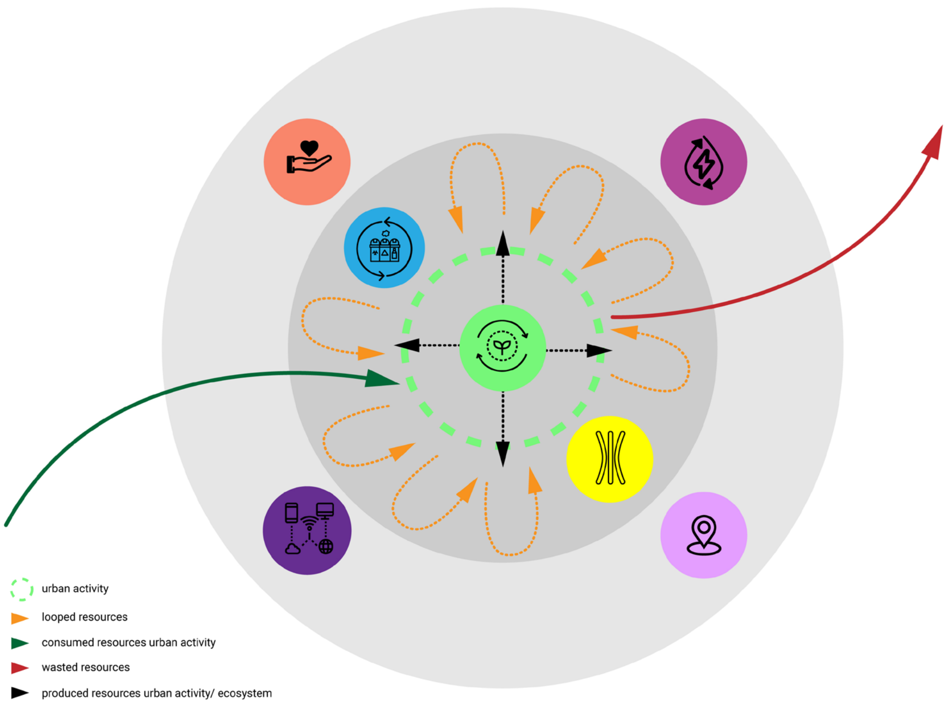


Figure 4.3 A circular approach to resource management in cities by Williams 2019

This Circular City framework provides an indication to practitioners and managing authorities about the sequence of actions to be approached. Nevertheless, this framework requires still further exploration, as it concentrates on delivering Circular Actions and not focusing on the diagnosis methods to determine these Circular Actions. Moreover, it lacks an approach of the stakeholders included and data collection methods.

On that perspective, this scoping study will address in the next section a focus on the policy cycle governance, to implement the Circular Actions diagnosed in this of this Circular City model through a Systemic Design approach.

4.6 Governance for Circular City model

How to implement a Circular City model successfully? What kind of governance is needed to make this model's policy cycle resilient and endurable over time? Today city governments are more aware of urban metabolism effects and how their policy cycles can shape the success or the collapse of resilience in cities (Healey, 2018; Turcu, 2018).

As underlined in Chapter 2, the cities traditionally face the challenge of governance in "silos" that it is reinforced by a top-down approach, which hampers their transition towards circularity. For instance, in the case of the Circular City model, governance fails to regard it as a matter of distribution and regulation of resources across the city, disregarding the city as an urban ecosystem and it is the emerging relations among local stakeholder and assets. On that view, the government-centred approach for governing is not adequate to comprehend decision-making in society. So, to achieve a successful implementation of a Circular City model is necessary a co-design approach of governance strategies to accomplish a systemic change of the environmental, economic and socio-technical systems (Loorbachand et al., 2016). This participatory approach in governance policy cycle requires a multi-level network of city stakeholders such as corporations, institutions, citizens and third sector organisations, in order to target efficiently local policies in cities towards CE.

Moreover, as widely discussed in Chapter 2, this reflects the need for more flexible policies that can adapt to the wicked problems changing reality. Therefore, to implement a Circular City model is necessary to rethink the role of public policy and their cycles, that could lead a collective innovation process towards value creation in an urban ecosystem (Mazzucato, 2018).

The emphasis of these critical perspectives on governance policy cycles is approached in Chapter 2, addressing an approach firmly in rooted in the construction of more systemic views of the proposed scenarios, in this case, post-industrial precincts, that can lead a better process of scaling up into policymakers and to the top-down implementation of holistic policies that include bottom-up and top-down definitions (Krauz, 2016).

On that perspective, several attempts on CE frameworks to convey bottom-up and top-down initiatives have been proposed previously (Prenderville et al., 2018; Lieder & Rashid, 2016; Pomponi & Moncaster, 2016; Ghisellini et al., 2016). For instance, Lieder and Rashid (2016) define a broad framework, which implies a joined top-down (policy levels) and bottom-up (industry shifts in the supply chain). On the other hand, Pomponi and Moncaster (2016) propose a CE framework that applies top-down and bottom-up approaches which regarded evenly as the effect of grassroots innovation could be as crucial to the innovative governmental policies. Lastly, there is Vergragt (2014) who suggest an approach where citizens driving sustainable lifestyles can advocate and participate in governance.

To clarify in this case, what is intended by Bottom-up innovation in CE is required to define that this approach regards the community actions generating innovative solutions for sustainable development on a local context (Smith & Seyfang, 2007; Forrest & Wiek, 2014; Seyfang et al., 2014; Van der Schoor & Scholtens, 2015; Kohtala & Hyysalo, 2015). Among the most common examples of Bottom-up initiatives are (see section 3.8.1.1):

- Community initiative local energy production
- Innovative maker-centres, public workshops that grant access to tools and skills.
- Repair and reuse networks or platforms where good can be shred or fixed.
- Local food production initiatives.
- Community platforms for sharing services, skills and assets
- Community local currency.

On the other hand, the top-down in a CE perspective implies an approach based on legislation and policy, which managing authorities employ to progress towards a Circular City. Among the most common examples of top-down initiatives are (see section 3.8.1.1):

- City Master Plans.
- Regeneration programmes,
- Environmental strategies,
- Re-industrialisation plans
- Public funded projects.

This combined framework for Circular City models allows identifying the relationships generated by grassroots and government actions as a critical asset. Nevertheless, applying such a governance approach to Circular City models implies inevitably to confront the nature of a city's "wicked problems" (see section 2.1). So to overcome such challenges this examination identify that design practices such as Systemic Design can serve as mediators (see section 2.2) for the bottom-up and top-down approach to deliver through a co-design practice an iterative horizontal dialogue and strategic thinking among stakeholders on CE policy-making process (or policy cycle).

4.6.1 Co-design a Circurlar City Model

To further unpack this, in order to reach objective 2. *"a theoretical proposition to co-design a Circular City framework tailored to Post-industrial precincts"*. This Chapter has unfolded the conceptualisation of a Circular City model and how government must approach such models. So, relating this to the stated research problem (Chapter 1), which stated the need to investigate further in which ways a the Systemic Design approach to CE policy can establish a more inclusive and cohesive Circular City model relationship with the context to develop local value. Afterwards, the literature review outcomes in (Chapter 2) narrow the examination introducing a Systemic Design as a methodology to approach CE policy design as it delivers a holistic territorial diagnosis and value creation strategies that respond to the system challenges, in order to generate innovative governance models for the CE policy cycle (Table 2.6). Such outcomes poised Systemic Design as a practical co-design approach for CE governance policyc cycle which in this section can be overlapped with the scoped review unfolded until now in this Chapter 4 on Circular City models. Therefore, in the next sections, this examination will narrow this research into describing how the Systemic Design method can co-design a CE policy cycles to deliver better governance and strategies for a Circular City model within post-industrial precincts, base on the SD methodological steps described in Chapter 3. Therefore, generating a Circular City model that is tailored to pull different CE activities that coexist to deliver social and economic welfare are activating new mechanisms to reactivate the value in these deprived areas.

4.7 Systemic Design delivering Circular City models for Post-indutrial precincts

Through most of the XX century, industrial precincts prospered due to strong industrial relations between the industry and government which deliver social well-being and local consumption systems (Kazepov, 2005). In particular, after WWII, these upcoming precincts were built with the aim of economic prosperity and welfare for the working class. Called "Fordist cities" they went through an accelerated expansion of industrial infrastructure from factories, warehouses, railroads, and harbours, to massive developments of social welfare infrastructure such as housing, community centres, schools, public services and recreational areas (Cucca & Rancci, 2017).

Nevertheless, in the last decades, these production epicentres suffered the negative consequences of the shifting global economic trends towards dematerialised/service-based economy and the decentralisation of production value chains. As a consequence, these precincts from a market demand perspective could not cope with the upcoming economic trends, creating economic recession, increasing unemployment, and population decay. Inevitably, this booming precincts converted into abandoned areas with predominantly brownfields and outdated urban fabric.

These phenomena brought the rise of post-industrial precincts evidence a the disconnection between economic growth and social welfare (Cucca & Rancci, 2017) as these precincts were shaped by a single economic drive which determines the other socio-environmental flows (Boudreau & Keil, 2006; Tarr 2002). Such accelerated changes lead to acknowledging these urban environments as challenging precincts to address sustainable development issues (Bulkeley et al., 2011).

Several sources have highlighted the increasing interest in post-industrial precincts across social, environmental and economic sectors (ICLEI, 2018), at the same time many city governments recognise these urban environments as challenging precincts to address sustainable development issues (Bulkeley et al., 2011).

Today, many post-industrial precincts encounter critical issues to renovate their infrastructure and services to meet current and future needs. In order to overcome the systemic consequences of deindustrialisation, these precincts require to reconfigure their urban identity to support urban transitions on regenerating sustainable livelihoods (ICLEI, 2018). Other scholars have underlined that to support such post-industrial legacy it must be approached as 'hubs' for radical innovation towards flourishing resilient cities (Ernstson et al., 2010; Bulkeley & Broto, 2012). Still, there is the difficulty in re-activating these precincts remains in the governance side as various city policies across the years have approached this subject as simple revamping or regenerating meer physical infrastructure. This view keeps been delivering deprived areas.

This governance and current policy cycles of post-industrial precincts have reinforced the current linear economy model, which has increased exposure to the risks of unpredictable resource prices, job instability, and supply disruptions (Lazarevic et al., 2017). Besides, as local production decreases, the low costs in production and labour in Asia have put most cities economy at a disadvantage. As a result, most cities globally are producing and consuming not local resources in an unsustainable way.

On that view, to overcome the systemic effects of deindustrialisation, post-industrial precincts as the most critical site of cities present as an opportunity to apply from a governance perspective the Circular City model. As discussed previously, many cities are re-planning themselves and expanding into innovative approaches to circularity. From that view, the role of the city governments it is fundamental to lead urban sustainability issues and to tackle climate change at the city-level (Erickson & Tempest, 2014). However, for governments, it is still a significant challenge to translate the complex nature of such systemic problems (see Chapter 2) into a manageable strategy to address a Circular City model. The interconnected nature of such critical drivers has a significant impact on how public policy for the CE operates (Giraldo Nohra et al., 2020). This system transitions in the governance for a Circular City model will disrupt the current model of development and growth. On that perspective, city governments must support CE policy instruments that enhance local value which is cohesive with long-term environmental goals of a Circular City. Because of its systemic nature, a transition towards a Circular City model can not be solved with the traditional linear and analytical method of problem-solving, it is needed a radical shift in policymaking methods (Barbero & Giraldo Nohra, 2018).

On that view, it is necessary to disrupt this governance silos and the current policy cycles, in order to shift towards a more adaptive and collaborative circular policy framework. For this purpose, to understand how the implementation of a Circular City model and the networks that could facilitate can be governed, requires a holistic examination of their urban fabric, metabolism, economics, demography, local culture and current policy frameworks (Bulkeley et al., 2011; Monstadt, 2007). Such an approach could provide information about particular leverages and challenges on post-industrial precincts approach when transitioning to a CE.

In that context, and considering the aim of this research project "how a Systemic Design approach can support a Policy Design process on CE towards a Circular City model in post-industrial precincts." The narrowed literature review on (Chapter 2) targeted Systemic Design as a co-design methodology to address CE policy design, delivering a holistic territorial diagnosis for local value creation strategies that respond to the system challenges. Such outcomes poised Systemic Design as an efficient co-design approach for CE governance which means in the scope of this investigation to create resilient Circular City models in post-industrial precincts.

With this in mind, it must be considered that a systemic transition into the Circular City model in post-industrial precincts will require a transdisciplinary approach that involves designers, governments, citizens, industry and academia to co-create CE strategies including bottom-up and top-down that fit those precincts (Barbero, 2017). The SD approach will deliver a holistic overview of complex post-industrial scenarios which can activate a Circular City model that arises from the appraisal of the resources offered by post-industrial precincts.

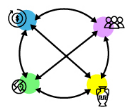
4.7.1 Systemic Design Framework for Circular Cities

In order to determine in which ways the Systemic Design can implement a more inclusive and cohesive policy design for a Circular City model in post-industrial precincts, this examination developed a framework (Figure 4.4). Such an approach was based on the Systemic Design method described in Chapter 3 and the Circular City framework proposed by Williams (2019b). The aim was to create a framework on the lens of the Systemic Design approach that diagnoses and asses post-industrial precincts into Circular City models, in order to support upcoming policymaking process. The proposed approach complements the research methodology described in Chapter 3 as it adds the findings on Circular City models scope examinations and narrows the project method towards post-industrial precincts. The following section will describe further the framework proposed in (Figure 4.4), which was conceived to co-design various CE strategies in post-industrial precincts that can coexist to address activating new mechanisms to for value creation in these deprived areas. Further on this framework will be applied in both case studies (Chapter 5 and 6).

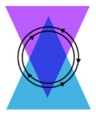
Figure 4.4 Systemic Design methodological steps for Circular City model Examination for Post-industrial precinct

1 HOLISTIC DIAGNOSIS

DATA CATEGORIES



POLICY FRAMEWORK ANALYSIS



STAKEHOLDER IDENTIFICATION

2 DEFINITION PROBLEMS & LEVERAGES

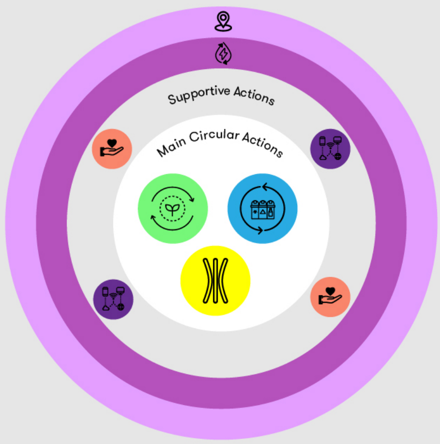
LOCAL ASSETS POTENTIAL LEVERS

- opportunity as value creation
- challenge as value creation

CURRENT LEVERS POLICIES & PROJECTS

- top-down
- bottom up

3 DESIGN THE SYSTEM



4 OUTCOMES EVALUATION

REGENERATE

- acuaponics
- urban farming
- regenarate soil
- pollinator biodiversity
- green walls
- water recycling

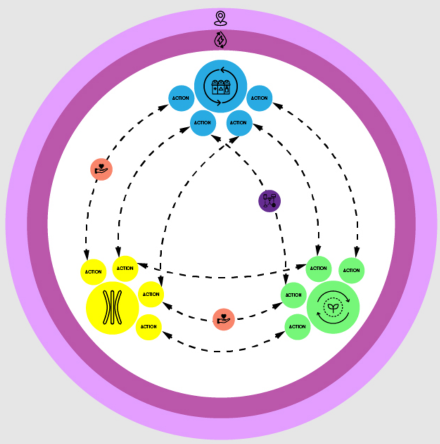
ADAPT

- reuse infrastructure
- flexible infrastructure /community
- retrofitting infrastructure

LOOP

- recycle
- reuse
- energy recover

5 IMPLEMENTATION



6 RESULTS ANALYSIS & FEEDBACK

CIRCULAR ECONOMY BARRIERS

cultural	economic	information	institutional
political	regulatory	technology	environment

IMPACT INDICATORS

urban fabric	demography	economy	culture

1) HOLISTIC DIAGNOSIS

On this first step of the Systemic Design Method, the complete overview of the post-industrial precinct system is addressed, a review of the origins and principles were already approached in Chapter 2. Furthermore, on section 3.9.1 it was explained in detail on the structural and organized process applied in this research project to Assess, Research, Collect, Visualize, Interpret (ARCVI)(Figure 3.3) the Holistic Diagnosis for the given context of this examination. This extensive analysis overview of the post-industrial precincts considers three main component (Figure 3.4); Data categories (Figure 3.5), Policy Framework Analysis (Figure 3.6) and Stakeholder Identification (Figure 3.7), which were implemented, as explained in detail in section 3.8.1.1. In each case study will be explained further how the Holistic Diagnosis was applied (Chapters 5 and 6). From a policy cycle perspective (Table 2.6) can be an influential tool for the policy cycle step 1 as it can deliver more effective targets to address the wicked problems.

2) DEFINITION OF PROBLEMS AND LEVERAGES FOR CHANGE

As previously explained in section 3.9.1.4 step implies an interpretation (Figure 3.8) of the visualization of the complex data collected in Holistic Diagnosis. In particular, to reach a Circular City model, it is necessary to overview the local assets critically, in order to target the local assets that could serve as potential levers and activate a systemic transition towards circularity and value creation. For this framework on post-industrial precincts, was defined as Local Assets Potential Levers:

- *Opportunity as value creation;* Identify the strength assets showcased in the HD, that could have the potential to activate a CE rooted action in the precinct that generates value, and it is connected more that one lever.

- *Challenge as value creation;* Identify the weak/critical assets showcased in the HD, that could have the potential to be addressed as an opportunity to activate a CE rooted action in the precinct that generates value. This approach is one of the significant features of the Systemic Design approach, which aims to address every local lever in order to support a system transition towards a Circular City model.

Furthermore, this analysis included an analysis of the HD, Policy Framework analysis, where it identified the current levers policies & projects that could support future CE strategies on a Circular City model. The examination allows an overview of the strategies (Bottom-up/Top-down) implemented over the years, to understand their effectiveness or their gaps/failures. From a policy cycle view (Table 2.6) can be an effective instrument for the policy cycle step 1 as it can produce more compelling targets to identify value creation sources.

3) DESIGN THE SYSTEM

As previously described in section 3.9, the current system is re-designed based on relationships between processes and actors in order to obtain zero emissions and create local value. To this aim, this step presents a new conceptualization of the circular actions and how this Systemic approach of Circular City actions is utilized as a co-design tool.

As this examination narrowed the scoping study towards the Circular City framework proposed by Williams (2019a), described in detailed the conceptualisation in section 4.5. The conceptualisation proposes two sets of city actions Main Circular Actions (Looping, Regenerating and Adapting)(Table 4.2) and Supporting Actions (Optimisation, Substitution, Localisation and Sharing) (Table 4.3).

Within the purpose of this framework, the conceptualisation was re-framed within the principles of the Systemic Design. This new diagram keeps the same Circular Actions proposed by Williams (2019a). However, this examination proposes to change the association approach between the actions in order to design the system (Circular City models in post-industrial precincts) on an autopoietic systems perspective. This new conceptualisation Systemic approach of Circular City framework actions has the following order (Figure 4.6):

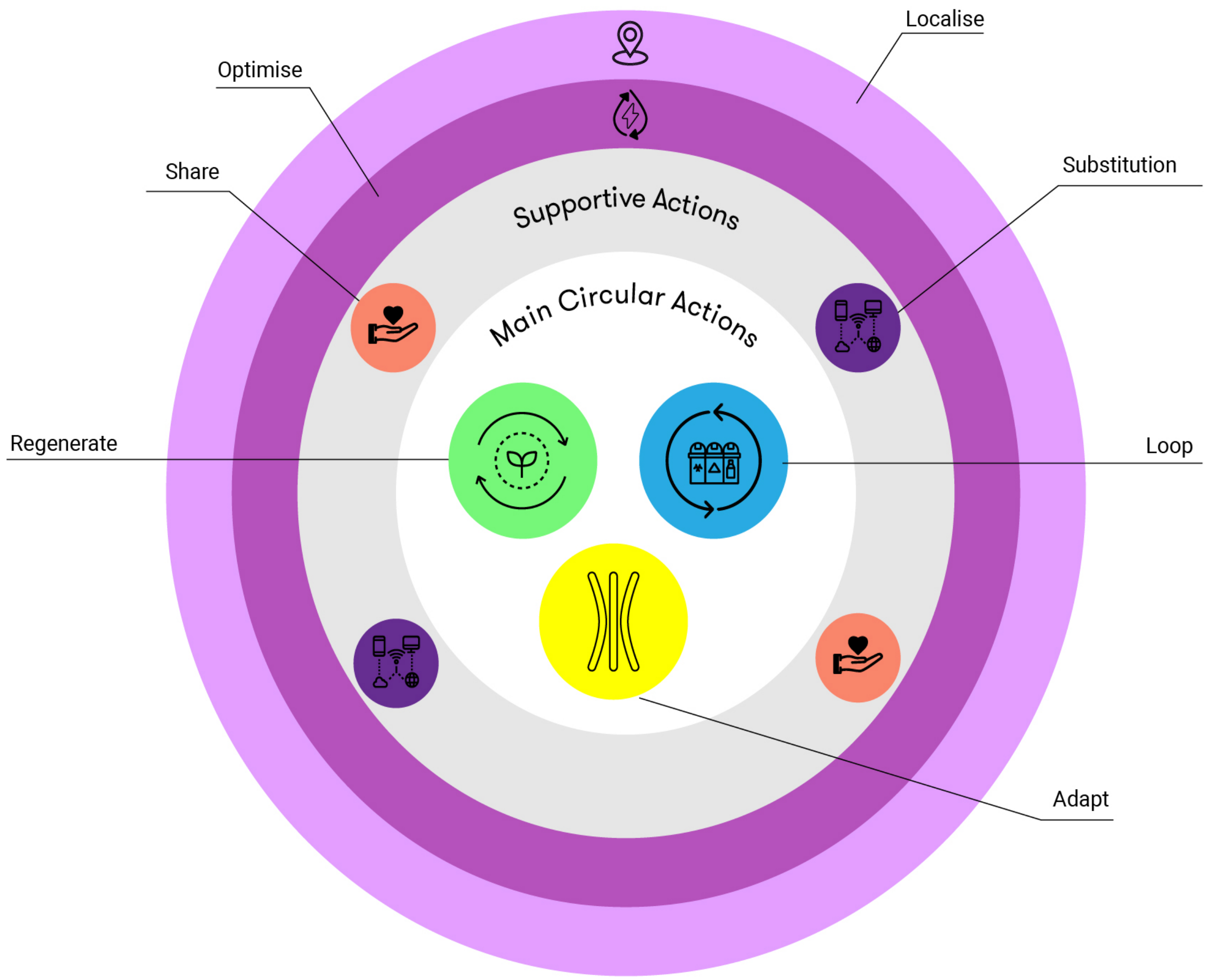
- *Localise:* This action wraps the entire Circular City framework as it stands by the core principle of Systemic Design approach towards creating local value and unlocking circularity. Such vision intends that in order to create a resilient Circular City model for post-industrial precincts, the local value creation must be at the core of the approach towards the enhancement of local resources from metabolism flows, urban fabric, social capital, heritage and among others. So, in this conceptualisation "localise" is an implied not as action but as an indicator that all strategies must imply in order to create an inclusive and cohesive Circular City model.

- *Optimise:* The second layer of the framework is optimisation as the following perspective on post-industrial precincts. Such action should be approached by optimising the consumption and production of local assets through efficient value chains in order to create value and decouple material and energy fluxes.

- *Regenerate, Adapt, Loop:* As proposed by Williams (2019a) framework, the core is focused first on the three main Circular Actions; which support the resource cycling processes in cities from natural to synthetic, allowing the urban ecosystem restoration and decoupling the resource consumption and waste. Step 2 outcomes will be filtered firstly through these core actions.

- *Share and Substitute:* Theses actions will remain on the role of support actions which can be used to reinforce these Circular Actions.

Figure 4.5 Systemic approach of Circular City actions



As Optimisation and Localise actions are mandatory prerequisites for all Circular Actions to happen, the framework should be approached firstly identifying the Main Circular Actions and subsequently the supporting actions.

Having defined the Systemic approach of Circular City actions (Figure 4.5), this step, in particular, merges the systems perspective combined the scope of a Circular City model in order to established co-design practices (co-creating sessions) for post-industrial precincts. On that view, co-design methods are used to identify how the local assets (outlined in the previous step) can be utilized on the Circular city actions proposed in Figure 4.5.

CO-CREATION SESSIONS

In order to address the 'Local Assets Potential Levers' outlined in the previous step, the researcher adopted the co-design approach (Parker & Parker's, 2007) with the selected stakeholders (the quadruple helix) to idenitfy and co-create of the circular strategies. The co-design sessions aim to generate locally situated knowledge that delivers a top-down/bottom-up approaches, conceiving a situation where all stakeholders become active participants of a value co-creation process (Wieland et al., 2012). Other scholars (Mattelmäki &Sleeswijk Visser, 2011), argue that such a co-design approach involves designers and stakeholders cooperating, envisioning and developing solutions, in this case, to assess the current assets into circular strategies.

A Roundtable Discussion format is the co-design practice this Design the Systems step. This choice was in line with the action format of a 'social innovation journey' defined by Meroni et al. (2013) as a non-linear series of steps and activities that allow stakeholders to set up and prototype a participatory innovation. For this reason, a roundtable discussion should be set up to showcase the outcomes of the previous step to a broader audience of stakeholders and capture a more overall panorama of the potential implementation of the Circular City model.

Furthermore, reflection throughout each case study was carried with the purpose of corroborating and enhancing the framework process identifying suggestions for further enquiry, in this particular case identifying local assets that could serve circular strategies (Figure 4.5) to co-design a new circular system and draw recommendations for the following framework step.

From a policy cycle view (Table 2.6) can be an effective instrument for the policy cycle step Policy Formulation as it delivers a co-design and particpatory review of policy strategies towards a more resilient system.

4) OUTCOMES EVALUATION

After approaching the outcomes of the HD on post-industrial precincts through the systemic conceptualisation of Circular City framework actions and the co-design session with the stakeholders, follows a first assessment of the by the main Circular Actions (Figure 4.6). This examination intends to classify the outcomes of the previous steps in to concrete CE strategies narrowed on main Circular Actions. Following the definitions stated in (Table 4.2) the implementation were exemplified for each action with the following potential strategies:

- *Regenerate:* aquaponics, green walls, pollinator biodiversity, urban farming, regenerate soil, water recycle

- *Adapt:* reuse infrastructure, retrofitting infrastructure, flexible infrastructure/ community

- *Loop:* recycle, reuse , energy recover.

This strategies could vary according to the holistic diagnosis of each context. This assessment intended to analyse the actions on the lens on their local levers identify previously and the co-desing stakeholder suggestions. The purpose of this examination was to understand what actions could have more local levers involved to be activated. On that perspective, it will deliver an overview of what actions could activate al Circular City model dynamics , following a 'Time-Based Design' outcome approach. From a policy cycle perpective (Table 2.6) can be an effective instrument for the policy cycle step Policy Adoption, which can provide a broader feasibility evaluation of the environmental, economic and social benefits, implying a governance foresight vision.

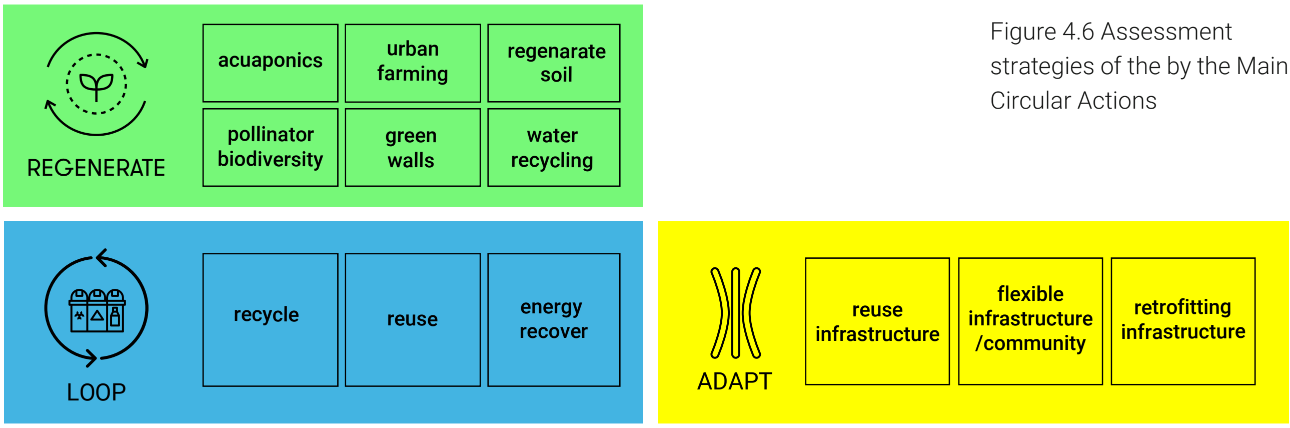


Figure 4.6 Assessment strategies of the by the Main Circular Actions

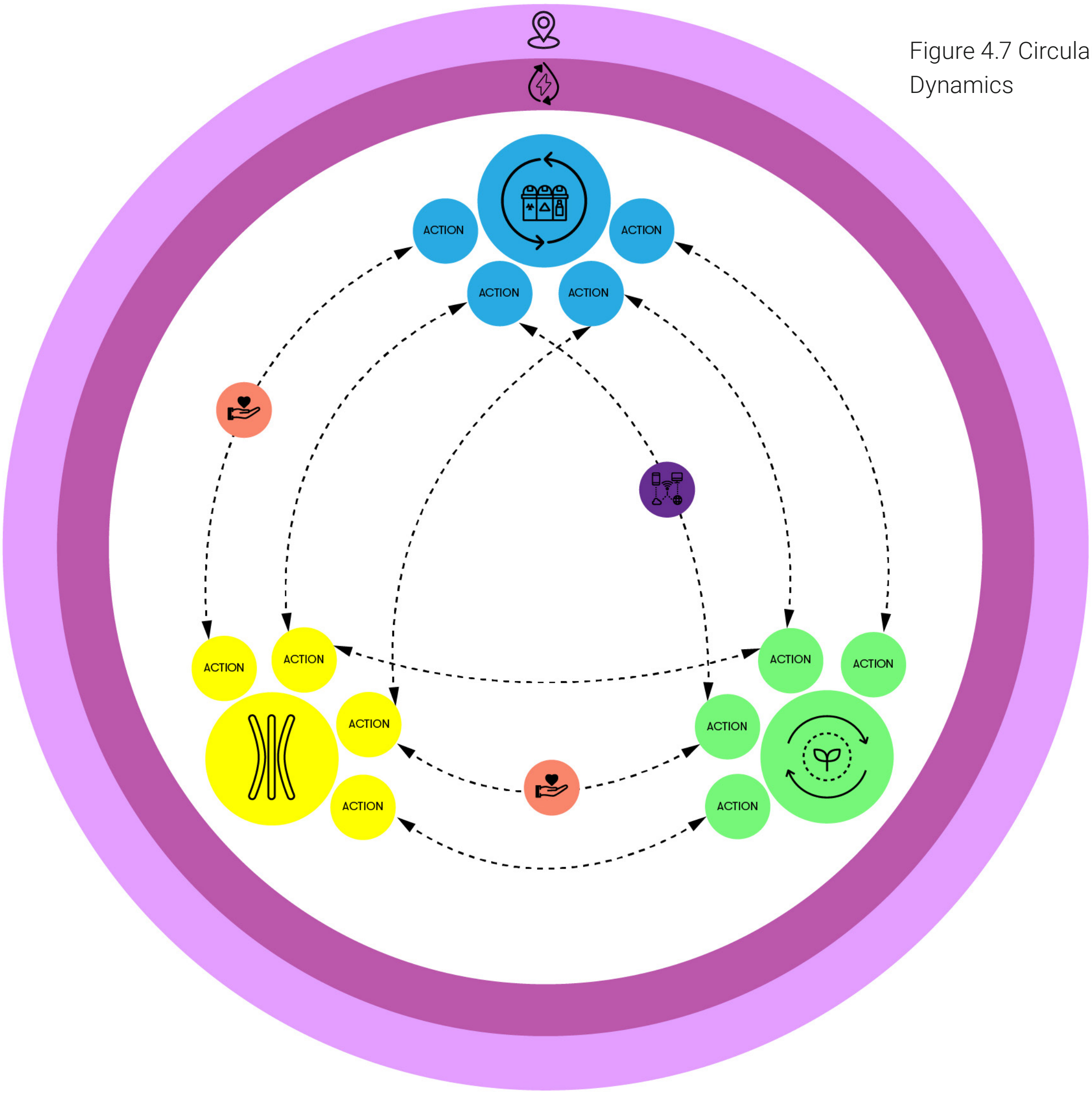


Figure 4.7 Circular Actions Dynamics

Circular Action	STRATEGY	IMPLEMENTATION	STATUS	STAKEHOLDERS	CROSS-CUTTING ACTIONS
Regeneration	Urban farming	Urban community farming program	executed	Third Sector	Loop

Table 4.4 Example identify cross-cutting actions

5) IMPLEMENTATION

In order to understand the system dynamics (Figure 4.7), in this part of the examination was established concrete implementations for each strategy within a short and long term perspective. Some identified implementations could be these 3 kinds ;

- *Executed:* means the circular strategy has already has taken place
- *Planed:* means the circular strategy is about to happen or in plans
- *Potential:* means the circular strategy has all of the levers and conditions to be implemented

The purpose of this is a gradual transition that should create local value and deliver more realistic and feasible new economic, environmental and participatory activities. For example (Table 4.4) approaches an example of how a Circular Action is analyzed through it's strategy, implementation (executed, planed, potential) and cross-cutting action. This last one is aimed to overview of what Circular Actions is related.

This relation among actions should generate a systemic dynamic which captured by (Figure 4.7), which will allow to understand what will look like the gradual implementation of a Circular City model in a post-industrial precinct. On this step is clear the 'Time-Based Design' approach as it delivers a comprehension allows of the environmental, societal and cultural features and processes across past, current and future landscapes of the precinct.

From a policy cycle view (Table 2.6) can be an effective instrument for the policy cycle step of the implementation as it can support a program development that can be executed with a short and long term policy plans.

6) RESULTS ANALYSIS AND FEEDBACK

The final step implies the assessment of the Circular Actions (or new circular system). The indicators can provide a useful political tool for monitoring progress and allocating funds to circular regeneration. For this purpose, they are analyzed through the lens of the Circular Economy Barriers (Table 2.3) and impact indicators (Table 4.5)- based on the expected results on urban fabric, demography, economy and culture. Both filters can present a beneficial governmental mechanism for monitoring progress and allocating funds to Circular City models. Moreover, this feedback analysis could advise potential problems generated by adopting these actions or collateral effects. Therefore, ensuring continuous evolution towards an autopoietic post-industrial precinct the ultimate proof to know a territory has transitioned to a Circular City model.

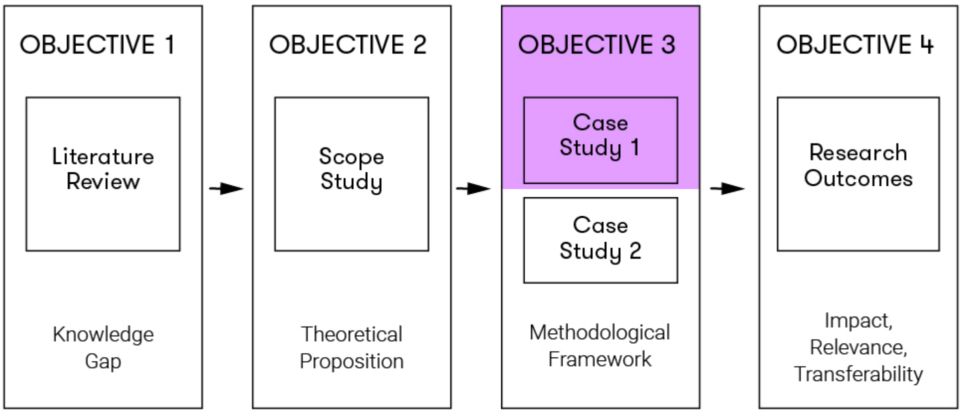
The framework established ways in which Systemic Design can diagnose and assess a more inclusive and cohesive policy design for a Circular City model in post-industrial precincts. The intended approach complements the research methodology described in Chapter 3 as it adds the findings on Circular City models scope examinations and narrows the project method towards post-industrial precincts. Hence, the following Case Studies were undertaken, informed by the conceptual framework developed to evaluate it in a real-world context. On a policy cycle perspective (Table 2.6) can be an effective instrument for the policy cycle step Evaluation through an assessment of the implemented system from an autopoietic point of that intends to measure the resilience level (economic, environmental and sociotechnical) of the proposed policy strategy.

Table 4.5 Circular Actions Implementation Impacts

	IMPLEMENTATION IMPACTS
Urban Fabric	Reduce CO_2 emissions, Reduce air pollutants, Increase of leisure/recreational spaces in Green Space, Increase of biodiversity, Reduction of a heat island effect, Increase energy efficiency retrofitting effect, Increase land use for agriculture, Reduce brown field areas, Increase of energy optimization in neighborhood infrastructure, Increase of spaces for businesses and local activities, Increase regenerated areas, Improve infrastructure quality, Increase amount of infrastructure for civic commons purpose.
Demography	Decrease of chronics diseases, Improve mental health, Increase of social cohesion, Improve learning performance, Improve food security indicators, Improve of indicators of healthy diets.
Economy	Optimization of local energy systems, Increase savings of public expenditure, Increase circular SMEs, Increase skills diversification, Increase awareness on CE investment programs, Increase number of local jobs, Reduction of waste going to landfill, Increase quantity of recycled material (industrial/household).
Culture	Increase environmental awareness, Increased community participation, Increase the local know-how, Increase of Green Public procurement, reactivate historical heritage, Increase promotion heritage of local products, Increased community participation.

Chapter 5

Mirafiori South precinct Case study



This chapter introduces the Mirafiori South precinct Case Study, addressing research objective 3, "developing Systemic Design approaches for Circular City frameworks to co-designing situated circular strategies for decision-making·" on a global north context. The following Case Study was undertaken, informed by the Systemic Design Framework for Circular Cities in Post-industrial precincts (Figure 4.4) developed to evaluate it in a real-world context.

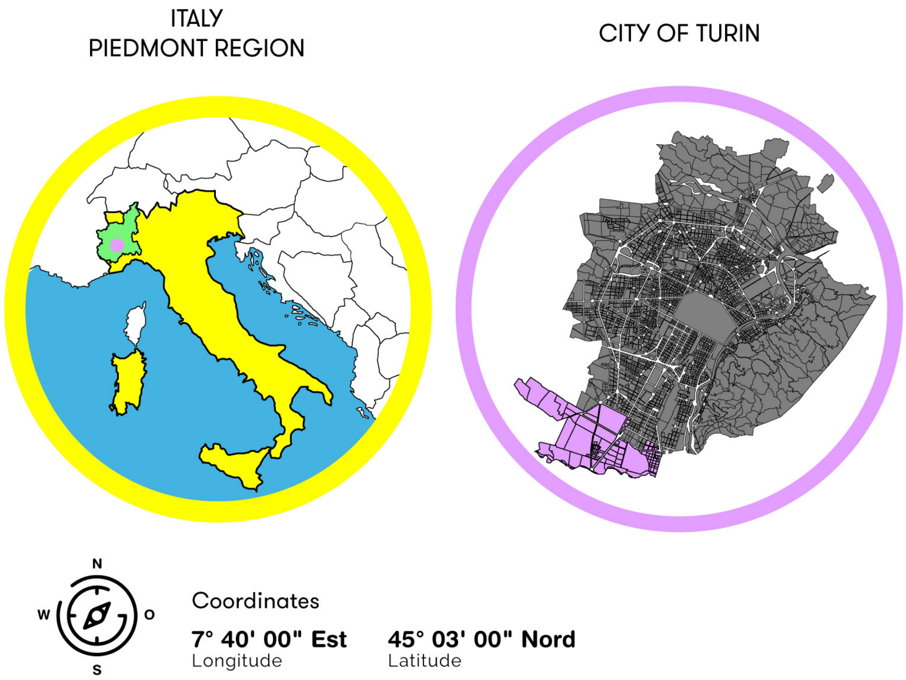


Figure 5.1 Mirafiori South Coordinates.

5.1. Introduction

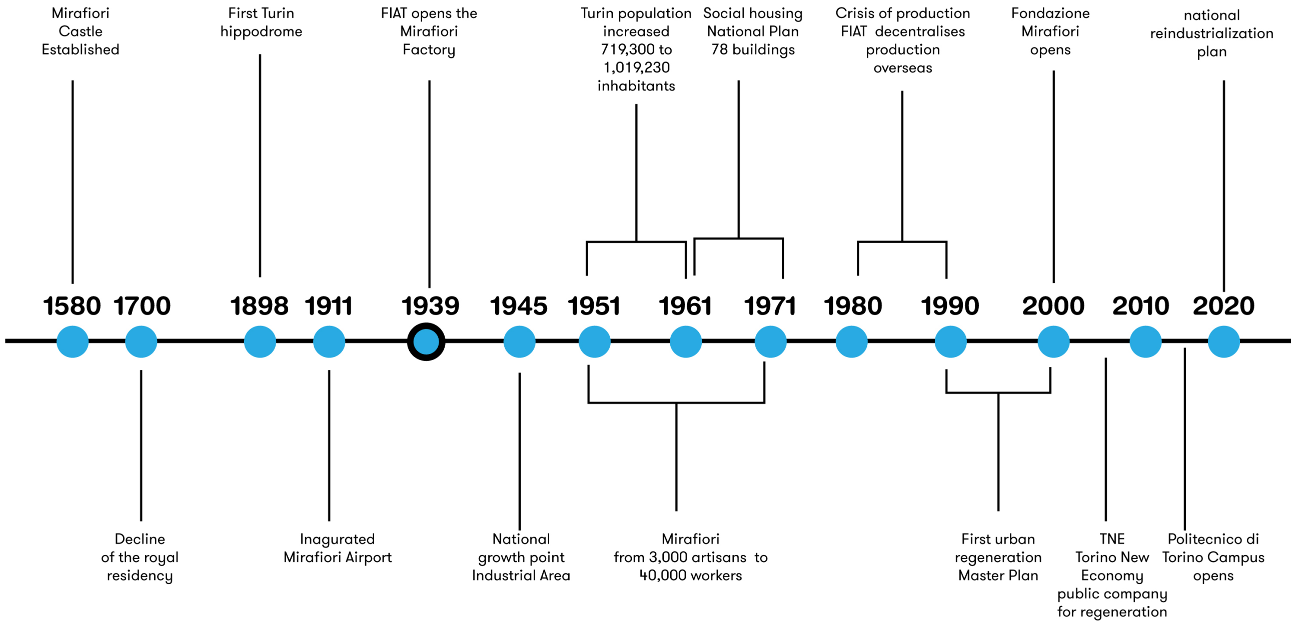
The decision to focus this study on the post-industrial precinct of Mirafiori South was because it is one of the most significant examples of Italian city-factory characterised by a relentless process of physical, cultural and social degradation. Located in Turin capital of the Piedmont region (North-West Italy), the post-industrial precinct consists of 40.000 inhabitants across 12km (Figure 5.1)(Figure 5.2). Mirafiori South was regarded an exemplary case to investigate as it was considered to be the heart of the Fordist model of automotive mass production, the history of Italy (Olmo, 1997)(Figure 5.3).

The name “Mirafiori” instead, derives from the Castle of Miraflores, built-in 1580 on the northern banks of the Sangone river, owned by the Savoy. The castle was called Mira-fiori, then donated by Carlo Emanuele I to his bride Catherine of Habsburg and Spain and a village then formed around the castle (1617)(Figure 5.4.). During the XVII century, the castle then began its decline due to the French incursions and as the Savoy decided to build their residences elsewhere, in Venaria and Stupinigi. In 1898 the first Turin hippodrome was established as a place of leisure for the bourgeoisie and international competitions until 1960 when was abandoned, to make room for the new district of tall buildings (Figure 5.5). In the winter of 1911, it is constructed the Turin-Mirafiori Airport (“Gino Lisa Airport”) for used for military purposes, its t was dismantled after the Second World War 1953, to make room for the current Colonnetti Park. (Olmo, 1997).

On 1939 the precinct history was embedded with the history of FIAT (Fabbrica Italiana Automobili Torino - Italian Automobiles Factory, Turin), a company has made Turin the ‘automobile city’ (Figure 5.6.). On that year FIAT opens the Mirafiori establishment transforming the precinct into the workers’ district par excellence: subsequently expanded and from that moment it established rhythms for decades thousands of families every day, determining their movements, organising their time for work and after work. After World War II 1951-1961, FIAT production accelerated considerably (Figure 5.7); consequently, the city population increased from 719,300 to 1,019,230 inhabitants (Figure 5.9). From 1951-1971 the population of Mirafiori South suffers exponential growth from 3,000 artisans and farmers, up to over 40,000, mostly workers at the FIAT production plant. The expansion of the company influenced high waves of internal migration that brought many people from

Figure 5.2 Mirafiori South, satellite map. Courtesy of Google maps 2019

Figure 5.3 Mirafiori History timeline, event highlights



the southern regions of the country. As this massive increase of population, the accelerated process of urbanisation of the district influence morphology of the buildings, the social character of the population makes visible the relationship between capital and labour of mass industrial production (De Filippi & Vassallo, 2016). As a result, from 1965 to 1968 came the massive construction of 78 buildings part of the Social housing National Plan (Figure 5.10)(Figure 5.11)(Figure 5.12)(Figure 5.13). From that moment the district presents the characteristics of an enclave: a concentration of people with a high incidence of social problems and a strong cultural mix, physically isolated and socially separated from the surrounding areas (Bagnasco, 1986, 1990). In 1971 the population of Turin reached its historical maximum 1,200,000 inhabitants, with a growth of over 60% compared to twenty years earlier, due to the Mirafiori South precinct.

The crisis of production of the 80s brings the slow agony of the FIAT puts an end to the city-factory

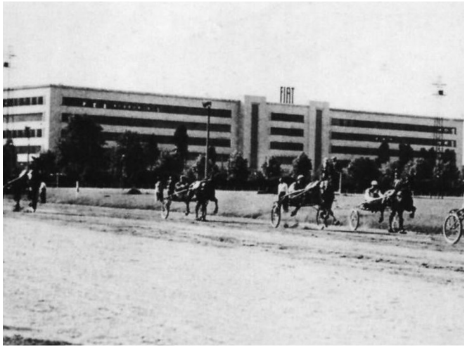


Figure 5.4 Castle of Miraflores, Courtesy Turin Historical archive.

Figure 5.5 Turin hippodrome 1920. Courtesy Turin Historical archive.

Figure 5.6 Mirafiori FIAT Industrial complex 1950. Courtesy Turin Historical archive.

Figure 5.7 Fiat Factory 1960 - Courtesy Turin Historical archive.

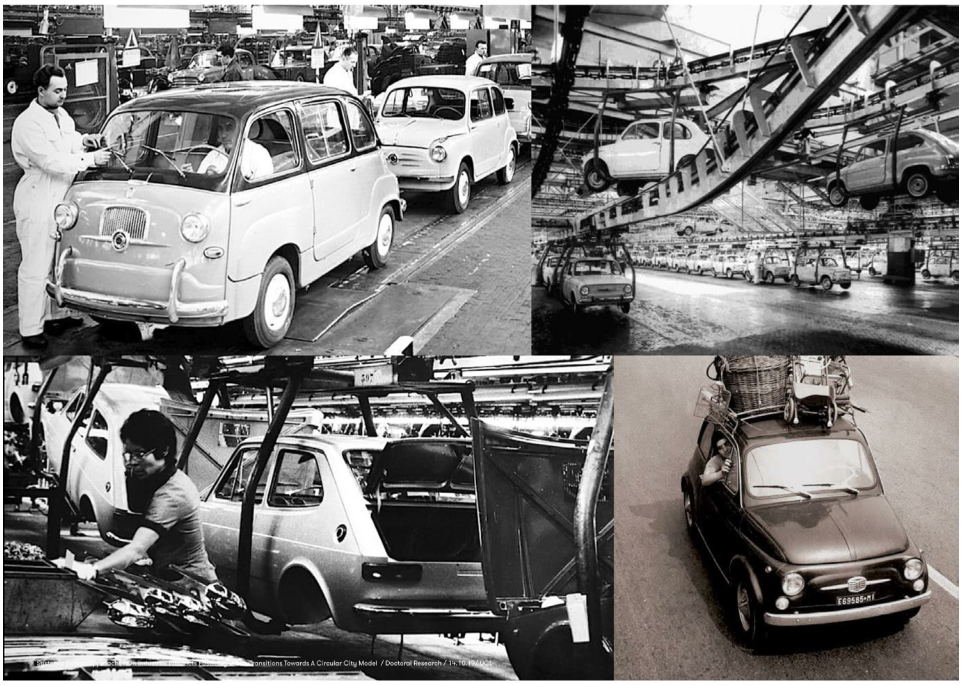


Figure 5.8 FIAT factory and production 1950-1960 - Courtesy Turin Historical archive.

Figure 5.9 Mirafiori precinct via Oronato Vigliani 1950. - Courtesy Turin Historical Archive.

Figure 5.10 Mirafiori South Social Housing program 1951-1971 - Courtesy Turin archive.

Figure 5.11 Mirafiori South areal shoot housing program 1951-1971 - Courtesy Mirafiori Dopo il mito project 2019

Figure 5.12 Mirafiori Social Housing program 1951-1971 - Courtesy author Mirafiori areal shoot housing - Courtesy Turin archive.

Figure 5.13 Mirafiori Social Housing program 1951-1971 - Courtesy Mirafiori Dopo il mito project 2019

Figure 5.14 Mirafiori areal shoot housing 2019 - Courtesy author

Figure 5.15 First Fiat residential settlements between, fields and farmsteads, racecourse in the background; 1960s; Courtesy Turin Historical archive.

Figure 5.16 Consolidated district, on the left Colonnetti park and CUS systems; 2017 Courtesy Google, Data SIO, NOAA, US Navy, GEBCO, Landsat / Copernicus

Figure 5.17 FIAT brownfields infrastructure 2019 - Courtesy author

season, as it decentralises it is production towards other countries (Figure 5.17)(Figure 5.18)(Figure 5.21). These phenomena lead to the 'radicalisation of the abandonment process', progressive depletion of residential buildings and the reduced commercial activities (De Filippi & Vassallo, 2016). Mirafiori South precinct, without FIAT, becomes the most evident space of social, spacial and economic segregation. Production, community and private property not only defined the value of the use of the heritage of the Fordist city but transformed an abstract space in place (Olmo, 2010). In the 90's crisis of Fordism in Mirafiori South, neglected more than six million square metres of deprived industrial domains, meant it was required to deal with a vast urban 'emptiness'. In order to tackle such de-industrialisation phenomenon, the City of Turin began to address the problems of social and economic decline through an urban regeneration Master Plan (1995-2001) (Marra et al., 2016). However, these different urban regeneration projects were promoted to preserve and enhance the urban fabric and Post-industrial cultural heritage sites, to give a new image to the district. Nevertheless, despite the vast amount of resources and expertise, they have always reached a modest outcome instead

On 2005 robust plans for reindustrialising were settled, with the creation of the public company TNE -Torino New Economy which is in charge for the enhancement of the former industrial areas, abandoned by the Fiat Company. The company directly manages the implementation of the redevelopment and enhancement initiatives on the abandoned industrial areas. As a result of this regeneration process came Politecnico di Torino Mirafiori campus - Cittadella Politecnica del Design e della Mobilità Sostenibili campus on ex-industrial (Figure 5.23). On 2019, the national government announced a massive amount of stimulus to create e re-industrialisation program on aerospace and automotive lead by Politecnico di Torino and FIAT

Due to this long history, to the government has targeted the precinct to be a Living Lab to experiment with circular economy strategies, this comes from the purpose to transform it on the first circular precinct of Turin. Such aim is supported by the Torino City Lab is an initiative-platform aimed at creating simplified conditions for companies interested in conducting testing in real conditions of innovative solutions for urban living and Circular Economy (CE). With this in

Figure 5.18 FIAT brownfields infrastructure 2019 - Courtesy author

Figure 5.19 Mirafiori plant isolated between the fields; 1950s - Courtesy Mirafiori Dopo il mito project
Figure 5.20. Fiat Mirafiori area, with expansion to the South West and surrounding buildings 2017 Courtesy Google, Data SIO, NOAA, US Navy, GEBCO, Landsat / Copernicus

mind, working in a close partnership with the City officials and stakeholders, the examination of this precinct is an opportunity for this research project to apply the proposed framework and ease a decision-making process towards a resilient Circular City model on a Global North perspective.

5.1.1. Aim and Objectives

This study aimed to develop the Systemic Design Framework for Circular Cities in Post-industrial precincts and co-design Circular City model decision-making process in Mirafiori South precinct. To that aim, the following objectives were set:

1. To deliver a holistic system panorama of all Mirafiori's post-industrial precinct assets.
2. To identify the current local assets from opportunities to challenges as leverages for value creation.
3. To Co-design (Round Table format) a the current system based on the conceptualisation of a Systemic approach on Circular City framework.
4. To identify potential or executed strategies around the main Circular Actions (Regenerate, Adapt, Loop).
5. To establish system dynamics through concrete implementations for each strategy potential or already executed.
6. To assess the proposed Circular Actions through the lens of the Circular Economy Barriers and impact indicators.

Figure 5.21 Mirafiori areal shoot FIAT industrial land 2019 - Courtesy Mirafiori Dopo il mito project

Figure 5.22 Mirafiori areal shoot FIAT industrial land 2019 - Courtesy Mirafiori Dopo il mito project

Figure 5.23 Politecnico di Torino Mirafiori campus - Cittadella Politecnica del Design e della Mobilità Sostenibili campus on ex-industrial FIAT (2012) - Courtesy Dipartment of architetture and design Politecnico di Torino

	METHOD STEPS	OBJECTIVES	RESULTS
1	**Holistic Diagnosis**	To deliver a holistic system panorama of all Mirafiori's post-industrial precinct assets.	-Data Collection (Desk and Field research) -Visualization of the complex data collected. -Identification of Policy framework and Map of stakeholders. -A common understanding of the current state of the art of Mirafiori South.
2	**Definition of problems and leverages for change**	To identify the current local assets from opportunities to challenges as leverages for value creation.	-A critical overview of the local assets, in order to target the local assets that could serve as potential levers for circularity. -Awareness of holistic challenges issues in Mirafiori South precinct that hamper circularity but could represent an opportunity. (challenges into opportunities) -Awareness in opportunities that foster a Circular City model in Mirafiori South precinct. - A shared understanding of the current levers presents on Mirafiori South that could support future CE strategies on a Circular City model.
3	**Design the system**	To Co-design the current system based on the conceptualisation of a Systemic approach on Circular City framework.	- Mirafiori's local levers reframed in relation to the Circular City framework. - Challenges and opportunities targeted by single or several Circular Actions, towards local value creation.
4	**Outcomes Evaluation**	Need of a long-term vision of multi-governance policy strategies	- Refined the main Circular Actions into targeted strategies for value creation in Mirafiori South precinct. -Awareness of Circular Actions that involved more local levers. (Circular Action that activates a Circular City model).
5	**Implementation**	To establish system dynamics through concrete implementations for each strategy potential or already executed	-Opportunity for each strategy within a short- and long-term perspective. -Awareness of cross-cutting action implementation. (relation among actions should generate a systemic dynamic). -Systemic implementation of a Circular City model in Mirafiori South precinct. (that should create local value and deliver more realistic and feasible new economic, environmental and participatory activities)
6	**Results analysis and feedback**	To assess the proposed Circular Actions through the lens of the Circular Economy Barriers and impact indicators.	-The indicators provide a useful political tool for monitoring progress to allocate funds to Circular Actions in Mirafiori South precinct. (co-creation of circular economy policies) -Ensure continuous evolution towards an autopoietic Mirafiori South precinct (aa Circular City model transition). -The feedback analysis advises potential problems generated by adopting these actions or collateral effects.

Table 5.1 Mirafiori South examination study, method

5.2 Project Method

Applying established in the Systemic Design Framework for Circular Cities in Post-industrial precincts (Figure 4.4) the examination study was carried in 6 steps, each one targeted a specific objective and generating results (Table 5.1).

5.3 Holistic Diagnosis

The first stage of this research aimed to deliver a holistic system panorama of all Mirafiori's post-industrial precinct asset. To achieve that this research project applied a structural and organized process to elaborate, create, generate, configure, draft, and perform the Holistic Diagnosis. As explained in section 3.8.1.1, in order to frame and reveal problems efficiently in this Mirafiori South precinct case study the approached stages were; Assess, Research, Collect, Visualize, Interpret (ARCVI) (Figure 3.3). The "assessment" first stage defined the scope previously settling the system boundaries within the Mirafiori South precinct and determined by its political, geographical and cultural edges (Figure 5.1). In addition to this system boundaries, the applied framework scoped this research investigation within a Circular City model lens.

So, in order to deliver the objective set in (Table 5.1) " a holistic system panorama of all Mirafiori South post-industrial precinct asset" the Holistic Diagnosis considered within the Mirafiori South precinct the three main components already explained in section 3.8.1.1 which are; Data categories, Stakeholder identification and Policy Framework Analysis.

To explain how the components were approached within the stages (ARCVI), this section will be divided into two parts. First, it will be approached the "Research and Data Collection" and afterwards the "Visualise & Interpret" stages.

5.3.1 Research & Data Collection

The research and data collection stage were undertaken according to the mixed-method approach adopted by this investigation (see section 3.4 research strategy). Therefore, as specified in section 3.9.1.2 on the Mirafiori South precinct examination was applied data collection methods such as; desk research (quantitative method) and field research (qualitative method).

On that scope was approached the research and data collection for the three components of Mirafiori's Holistic diagnosis. On the following section, it will be approached the re-research and data collection stage of each one of the components; Data categories, Stakeholder Identification and Policy Framework Analysis. Moreover, is important to underline that the researcher approach in the three components in this stage simultaneously.

5.3.1.1. Data Categories

The data categories for the examination of Mirafiori South precinct were defined and further explained in section 3.8.1.1 (Urban Fabric, Demography, Economy, Culture)(Figure 3.5). This section specifies the sources and methods of these categories for the research and data collection of Mirafiori South precinct.

As this research project for the Mirafiori South precinct was supported by the City of Turin Department of Innovation and Smart City, the Desk research method got a considerable amount of the data as city authorities provide accessibility to the municipal databases. In the following (Table 5.2), are the primary sources and entities to gather the data each category focusing on description and challenges of the process.

After establishing all of the sources and research methods for each category, the data collection was set assembling the data gathered in these categories. In the case of the Mirafiori South precinct examination, the data was organised inside the format established in the framework assessment step (Annexes I). The information included references for each data in order to guarantee accuracy inside the analysis enabling tracing of information at all times. This organisation supported the researcher in further steps with a unified database outcome.

Parallel to this, field research was executed within the Mirafiori South precinct, mainly to verify with observations and vivid descriptions of the qualitative data collected at the desk research. Through these sites visits, it was registered the current- state of the art, which allowed the researcher to verify the data gather in the desk research (Figure 5.17)(Figure5.18)(Figure 5.12)(Figure 5.13). In the following section a full description of both desk and field research will be elaborated.

The system outcomes of this data collection gathered in (Annexes I) will be interpreted and visualized in the following section.

5.3.1.2 Policy framework

The research and data collection for the Mirafiori South precinct was executed as under the parameters described in section 3.8.1.1.; also, it was entirely conducted through a Desk Research approach (see section 3.8.1.2). Moreover, the analysis of Mirafiori South was firmly rooted in the construction of a more systemic approach that included bottom-up and top-down definitions (Krauz, 2016)(Figure 3.6), creating a panorama from current policies to grassroots actions regarding axes related to CE.

In order to reach a complete perspective on top-down approaches on Mirafiori South precinct, the researcher was supported by city officials who provided the documentation about all policies and programs applied in the area regarding axes related to CE on the last 30 years such as; city Master Plans, regeneration programmes, environmental strategies, re-industrialization plans and specific funded projects. This data was relevant to understand what top-down approaches have been successful or failure and comprehend the reasons why. This panorama is vital for further stages in the examination of this case study.

	DATABASE	ENTITY	OBSERVATIONS
Urban Fabric	**Census ISTAT**	Statistical office of the Piedmont Region	-Municipality databases provided most data sources for this category. - In case data was not available at the precinct level, the data was approached at levels of city or "Turin south". -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. - Particularly the case of waste management, each consortium provided their annual reports. -Some data was last updated ten years ago. -Data was in the Italian language. -The units among databases were always not uniformed or presented in unit required. -Difficult accessibility. (lack of cooperation with civil servants. -Some data was not available for the Precinct (was consider a city-level perspective). -The interface of the databases was challenging for research purposes.
	Urban land registry (GIS)	Geoportal of the Municipality of Turin	
	Territorial Agency for the Habitat	ATC Office /Social Housing	
	Environmental Data Report ARPA	ARPA - Piedmont regional Environmental Agency	
	Amiat Spa Annual report (2018)	Amiat Spa/ municipal waste company	
	Comieco Annual report (2018)	Comieco /National Consortium for Recovery and Recycling	
	Corepla Annual report (2018)	Corepla/ National Consortium for the Collection, Recycling and Recovery of Plastic Packaging	
	Coreve Annual report (2018	Coreve/ National consortium for the collection, recycling and recovery of glass	
Demography	**Census of the ISTAT (2011)**	Statistical office of the Piedmont Region	-Government and Research project databases provided most data sources for this category. Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request.. -Data was last updated five years ago. -Difficult accessibility. (lack of cooperation with civil servants. -Some data was not available for the Precinct (was consider a city-level perspective). -The interface of the databases was challenging for interpretation purposes
	Urban land registry (GIS)	Geoportal of the Municipality of Turin	
	Miraforum Report (2018)	Mirafiori Foundation ONG	
	H2020 ProGIreg SWOT (2018)	Municipality of Turin	
	Census EUROSTAT (2018)	EUROSTAT	
Economy	**Business Directory (2018)**	Piedmont Region - Sustainable Development and Qualification Sector of the production system of the territory	-Government and local databases provided most data sources for this category. -In particular, the Turin Chamber of commerce possessed most of the Industrial census state of the art -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. - Particularly the case of the industrial waste management was only available by type of waste not by quantity this could affect the results of the research. -The units among databases were always not uniformed or presented in unit required. -Difficult accessibility. (lack of cooperation with civil servants). -Some data was not available for the Precinct (was consider a city-level perspective). -The interface of the databases was challenging for research purposes.
	Urban land registry (GIS)	GeoMirafiori Foundation ONGof Turin	
	Industrial Environmental Database	Turin Chamber of Commerce	
	Miraforum Report (2018)	Mirafiori Foundation ONG	
Culture	**School Observatory**	City of Turin / Educational Services Department	-Mirafiori Foundation provided data for this category, as they have created an extensive database of the current projects of the precinct and their impact in the cultural background of the precinct. -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. - Some data sources were in the Italian language -The units among databases were always not uniformed or presented in unit required. -The interface of the databases was challenging for research purposes.
	H2020 ProGIreg SWOT (2018)	Municipality of Turin	
	CO-City Projects	Municipality of Turin	
	Projects AxTO	Municipality of Turin	
	Mirafiori Dopo il Mito	Mirafiori Foundation ONG	
	Miraforum Report (2018)	Mirafiori Foundation ONG	

Table 5.2 Database sources and entities to gather the data each category focusing on description and challenges of the process.

Table 5.3 Policy Framework analysis scheme

	TOP-DOWN	BOTTOM-UP
Urban Fabric	-**Urban Regeneration program Mirafiori South (**1996 - 2004) -**Torino Metropoli 2025;** The third strategic plan of the city, an economic and social development project for Turin and its metropolitan dimension. -**Metropolitan Strategic Plan 2018-2020,** -**Urban program ,2001** (regeneration strategy) -**Corona Verde Project**: conservation of natural parks in the metropolitan area of Turin -**Waste Management Program**; door collection to door (2003- 2019) -**ProGireg H2020 project** : Nature Based Solutions for post-industrial cities -**Legislative Decree 152/2006** - Environmental regulations in force since 12/11/2014) -**Regional Law 24/2002 - Rules for waste management** -**Provincial Waste Management Program (PPGR 2010)**	-**Mira up project project:** Initiative from third sector on interventions Civic commons to regenerate the area and reinforce identity. -**Piazza raggazabile project:** project Initiative from third sector on interventions Civic commons to regenerate the area and reinforce identity. (Figure 5.26) -**Mirafiori Bike Tour project***:* the creation of tourist services, usable for the promotion of the territory -**Orti Generali project***:* Urban gardening intervention in abandoned land, leased by the citizens. (Figure 5.25) (Figure 5.28)
Demography	-**AxTo fund- Action for the periphery of Turin/Project** Alloggiami: Co-housing project between elderly living in social housing and new upcoming students' (2017) (Figure 5.23) -**Urban Innovative Actions (UIA) Co-City** - urban commons /socio-spatial polarisation Urban poverty (2017 - 2020) -**FIAT Corporate Social Responsibility program.**	-**Casa nel Parco community center;** A socio-cultural and recreational resource to increase the knowledge and attendance of the Colonnetti Park and contribute to the redevelopment of the Via Artom area and the Mirafiori South district. A space for accommodating and supporting the associations that work in the area (i.e Slow Food) (Figure 5.24) (Figure 5.32) -**Una casa per tutti project***:* Social help desk for support and guidance/ interpersonal conflicts/victims of violence /Health desk /school of Italian for foreign/ game library. -**Essere Anziani project***:* To promote active aging through the active participation of the elderly in the life of the local community, the promotion of healthy lifestyles. -**2 Youth community centres** for teaching on crafts/ homework's/ repair/ cultural events -**5 Afters school projects***:* this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.
Economy	-**TNE (Turin New Economy) intervention company** (public capital) aimed to regenerate disused industrial areas into new urban redevelopment opportunities through the reindustrialization. -**National Reindustrialization Programme** (2019) -**PLANET APP – Mirafiori South***:* quick access to news, events, useful proposals to experience the neighbourhood. (Figure 5.34) -**National law n.134 of 2012 "support and development of electrical requalification"**	-**Mirafiori Solidale project***: is* a multi-year framework project that directs the actions that are carried out in the southern Mirafiori South area on the subject of employability and work by public, private and non-profit entities. (Figure 5.27) -**Vetrina per Mirafiori project***:* to support the merchants and socio-cultural realities of Mirafiori South to bet on a livelier neighbourhood. The project promotes these realities of the neighbourhood through a digital informative "showcase". -**Coprogettazione commercio project :**to support their planning and to encourage collaborations and partnerships. The theme is innovation and the review of service models for citizens, both economic / productive (profit) and social (non-profit). -**Fa bene project***:* The goal is to collect the spontaneous donations of fresh food from the buyers and the unsold food surpluses in the via Onorato Vigliani market and manage their redistribution to people and families in economic difficulty at Mirafiori South, in exchange for "return" actions in the neighborhood. (Figure 5.32) -**Carota project:** The goal is to contribute to combating poverty in the district by experimenting with a system of integrated and sustainable services to access food and to combat social exclusion that can provide the user with specific answers according to their needs. (Figure 5.33) -**Mirafiori non spreca project***:* A network of all Food Waste projects on going towards unique platform on waste recovery .(Figure 5.34) -**Mirafiori social Green association***:* Many collective events, courses, workshops, projects for the reuse of coffee grounds in collaboration with local bars and collective gardens, exchange activities and self-production on the theme of food and the environment.
Culture	-**Torino City Lab** is an initiative-platform aimed at creating simplified conditions for companies interested in conducting testing in real conditions of innovative solutions for urban living and Circular Economy. -**Mirafiori Cultura in Circolo;/ Mirafiori Culture in a Circle**. A series of laboratories at the Primo Levi Turin Institute (local high school), funded by the Ministry of Culture. This initiative intends to create Circular Economy awareness among the Mirafiori community, through different experimentation in products and services. (Figure 5.31)	-**Il quartiere al museo project***:* social inclusion project that aims to bring the museum heritage closer to the population groups traditionally less involved in cultural enjoyment. -**Mirafiori dopo il mito project***:* The project tells the story of the Mirafiori district after the productive divorce from Fiat, focusing attention on the physical and social transformations of the neighborhood and on the stories of the people who live in the area. (Figure 5.27)

In the other hand, for a complete panorama of the bottom-up approaches in Mirafiori South precinct, the researcher was supported by Mirafiori Foundation/Fondazione Mirafiori, the leading third sector organization of the precinct. The foundation is in an umbrella organization which has monitored and map grassroots actions and NGO organizations that have been in the precinct for the last 20 years. On that view, the Mirafiori foundation provided the researcher documentation about all grassroots actions and programs active in the area regarding axes related to CE. This data was relevant to understand how bottom-up approaches are delivering a state-of-the-art on the potentialities and challenges of local stakeholder interactions. Whose activities sometimes have built a more effective citizen-public administration relationships, promoting local development through actions on social innovation, entrepreneurship, health, food security, and cultural heritage.

The data collection of the top-down and bottom-up approaches in Mirafiori South precinct was synthesized in Table 5.3. In order to render this scouting effective for the next phases of analysis, the findings were categorized under the previously

Figure 5.24 Casa nel Parco /Fondazione Mirafiori 2019 - Courtesy Fondazione Mirafiori

Figure 5.25 AxTO and Orti generali / urban farms 2019 - Courtesy orti generali

Figure 5.26 Piazza Raggazabile at market in via onorato - Courtesy Fondazione Mirafiori

Figure 5.27 Mirafiori Solidale project, workshop with migrant population - Courtesy Fondazione Mirafiori

Figure 5.28 Orti generali / urban farms - Courtesy orti generali

Figure 5.29 Mirafiori dopo il mito project show case - Courtesy Fondazione Mirafiori

Figure 5.30 Fa bene project at market in via onorato - Courtesy Fondazione Mirafiori

Figure 5.31 Carota project at Casa del parco - Courtesy Fondazione Mirafiori

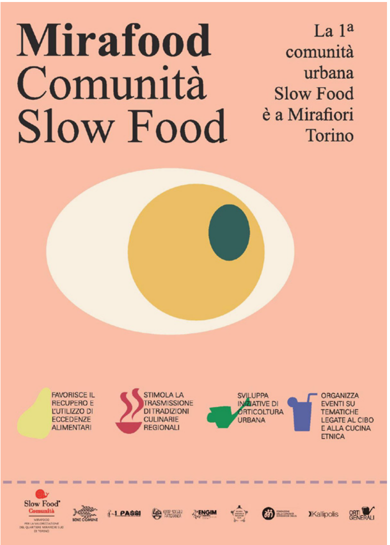


Figure 5.32 Mirafiori Slow Food Community events 2019.2020 to preserve and foster local food heritage partnership between Orti generali, Slow Food and Fondazione Mirafiori - Courtesy Fondazione Mirafiori

Figure 5.33 Mirafiori Cultura in Circolo inaguration event 2020 - Courtesy Fondazione Mirafiori

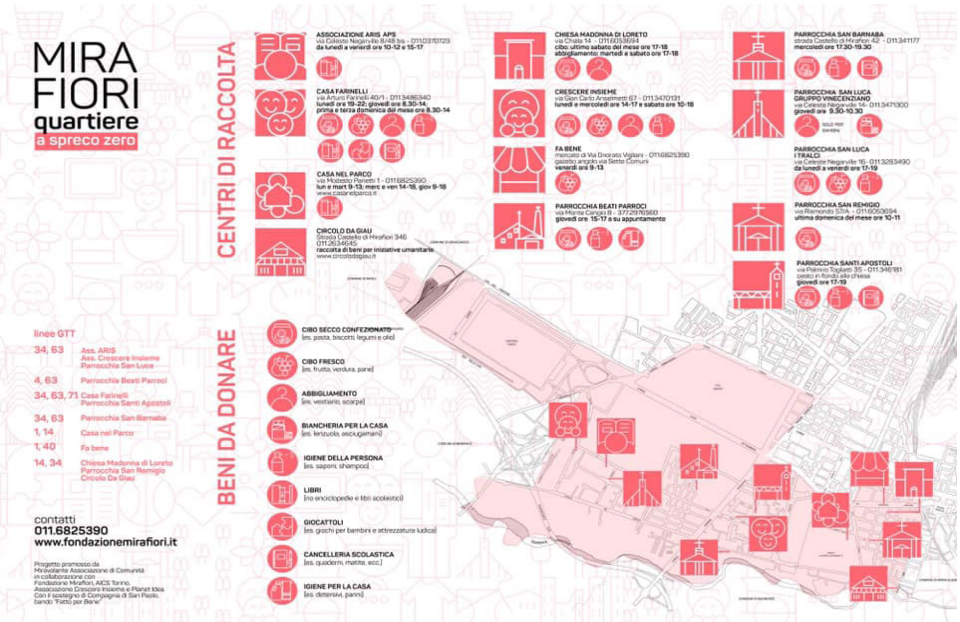


Figure 5.34 Zero waste map for household waste, Mirafiori non sprecca project and APP planet app 2019 - Courtesy Fondazione Mirafiori

stated categories -Urban Fabric, Demography, Economy, Culture-.

The overview of the Mirafiori South precinct policy framework delivered a state-of-the-art of the past-present and future regenerative actions on the social, economic and environmental aspects- highlighting the significant strengths and weaknesses.

From a top-down perspective, these instruments address regeneration as a multidimensional concept containing economic development, employment opportunities, services effectiveness, cultural and social regeneration, inclusion. These actions have to do with the economic dimension of sustainability, such as TNE (Turin New Economy) and National Reindustrialization Programme (2019). They aimed to reach opportunities offered by innovation through more efficient use of resources creating socio-economic value with minimum impact on natural systems. In particular, the Mirafiori South precinct since the begging of its decline in the ’90s the city government has stimulated a series of policies for urban regeneration, entrepreneurship and social cohesion such as Torino Metropoli 2025, AxTo - Action for the suburbs of Turin, Metropolitan Strategic Plan 2018-2020, Urban program 2001. Other coordinated actions focused on the efficiency of use of natural resources, but also landscape restoring and rehabilitation and sustainable economic models, such as the H2020 the proGIreg project on nature-based solutions for post-Industrial Cities, on the development of Living Labs in urban areas which face the challenge of post-industrial regeneration with Green Infrastructure. Nevertheless, these traditional regeneration instruments require to coordinate new forms of social inclusion of the community and stakeholders to activate public and private resources. Therefore, this research found 4 actions are trying to gain this coordination through the promotion of CE. On the one side there are Torino City Lab and Mirafiori Cultura in Circolo; which are aiming to run Mirafiori into an experimentation field for CE strategies in the city. Then Mirafiori non sprecca project with the PLANET app are creating a local platform to make available all sorts of resources of the neighbourhood from household waste, services, and cultural activities; these will be discussed later in the research process (Figure 5.34).

From a bottom-up panorama, it is clear that actions have a considerable higher impact, as they targeted interaction with citizens from a community heritage perspective (working-class precinct). The strong sense of belonging acts as a catalyst for initiatives that provide active participation of citizens in the co-design and implementation of interventions for the redevelopment and regeneration of collective spaces. Furthermore, it identified the relationships generated between the local and government actions as a critical asset. These grassroots actions are the most relevant of an entire network of 30 entities of the third sector present in the precinct. Whose activities have built a more effective citizen-public administration relationships and promoted local development through actions on social innovation, entrepreneurship, health, food security, and cultural heritage. In a perspective of co-planning and co-production of services and management of collective assets which facilitate the involvement and active participation of citizens, encouraging the inclusion of all the groups of communities involved in the process, with attention to the weaker groups. Last but not least, FIAT continues to be one vital player to bring regeneration on the area as they aimed to provide a strong CSR component that shows the commitment of the company to enrich the Post-industrial cultural heritage site.

The mapping of this policy scenario in Mirafiori South allows having a better comprehension of the role of all local actors essential for the development proposals grounded in the local context. Also, it created a multi-stakeholder dialogue which can support a CE policy transition and bottom-up process effectively.

5.3.1.3 Stakeholder Identification

The stakeholder identification of the Mirafiori South precinct was executed as described in section 3.8.1.1, this process was build based on the findings of data categories and Policy Framework Analysis described above.

Based on the Systemic Design principles the stakeholder identification on the Mirafiori South Precinct required to active cooperation with a quadruple helix model which implied governments, industries, communities and research institutions (Figure 3.7)(Barbero, 2017). For this reason, the researcher engaged with critical local partners to reach a more comprehensive engagement process on mapping and selection of stakeholders, that can influence the transition to the CE in public administration, business, associations, education and civil society (Ferrulli et al., 2019). Table 5.4 summarises the stakeholder selection based on a mutuality perspective, identifying a description the relevance of the research project for targeted stakeholder and, at the same time, the benefits stakeholders could gain from this examination.

On a first approach, the researcher identified the “lead stakeholders” for each category; City of Turin Department of Innovation and Smart City (government), Chamber of Commerce (industries), Mirafiori Foundation (communities) and Politecnico di Torino (research institutions)(see Table 5.4). This identification was followed upon a scoping activity, involving desk research, a round table session and visits to key the lead stakeholders and informal discussions aimed at assessing a whole identification process of stakeholders involved in a Circular City model.

5.4 Visualize & Interpret

After the data collection phase was finished, the researcher moves to the visualisation phase of the data within an inductive method, which eased the interpretation of the data complexity (Figure 3.3). This phase was executed according to the methodological steps described in section 3.8.1.3. On this visualisation made by the researcher applied the design skills and through a research synthesis, the graphic representation of the collected data, exposing their potential correlation. Allowing the reframe of Mirafiori South precinct wicked problems, highlighting the driving factors and sleeping assets. As a result, the infographic visualisation of the Mirafiori South precinct as a system mirror the complexity and wickedness of real-life networks of interconnected problems (Sevaldson, 2018).

Nevertheless, the interpretation of the database for the Mirafiori South precinct was challenging, given the difficulties presented on the data collection presented in Table 5.2. At that stage, the researcher had to synthesise information in order to highlight the potential visualisation to generate later connections between the categories (Urban Fabric-Demography- Economy- Culture).

Hence, this phase position the information on a common ground where all stakeholders could provide productive and collaborative feedback to the future CE strategies for Mirafiori South precinct. The researcher to displayed the information smoothly

QUADRUPLE HELIX	STAKEHOLDERS	DESCRIPTION
Community	**Mirafiori Foundation** *Lead stakeholder* FONDAZIONE DELLA COMUNITÀ DI MIRAFIORI ONLUS	The Mirafiori Foundation NGO collects public and private funds to help improve the Mirafiori South precinct from an environmental and social point of view, support the transformation processes started, increase equality of access to the opportunities of its inhabitants. The Foundation supports more than 30 local associations on fundraising and project proposals.
	30 Third Sector organizations	Mirafiori South precinct has over 30 ONG organizations that support grass-roots initiatives in the areas of Community, Economic Development, Education, Territory, Culture, and Social inclusion.
Industry	**Turin Chamber Of Commerce** *Lead stakeholder* CAMERA DI COMMERCIO INDUSTRIA ARTIGIANATO E AGRICOLTURA DI TORINO	Industry agency that supports companies, leading critical strategic initiatives, to contribute to the cities growth and development not only economic. They possess a database of over 220,000 companies operating in the city and province, represents the economic interests of the city. The chamber of commerce represents over 2732 businesses present in Mirafiori South precinct .
	FCA (Fiat Chrysler Automobile) & other manufacture companies	FIAT now FCA is still the biggest company in the precinct is the biggest employer; they have been highly involved in the development programs in the precinct. Among the 2732 companies based; 1465 companies Individual company, 442 companies Limited liability company, 276 companies, Limited partnerships, 211 companies General partnership and 338 other business.
Research	**Politecnico di Torino** *Lead stakeholder* POLITECNICO DI TORINO	The Politecnico di Torino as a research institute based in Mirafiori South, has several initiatives leading technology transfer in the area. Moreover, it has developed several educational and research projects with a network of 10 public schools in Mirafiori South precinct, bringing science and innovation.
	10 public Schools Network	The network of the ten public schools has been relevant for the dissemination of innovation and technology in the precinct. They have promoted experimentation of innovative technologies in the precinct, also to involve local young population. In the present is present the another relevant as research institution the University of Turin.
Government	**City of Turin Department of Innovation and Smart City** *Lead stakeholder* CITTA' DI TORINO	The Department of Innovation and Smart City of the city of Turin is involved in the investment of European and national funds for technology and social innovation. This office has targeted the Mirafiori South precinct to be a Living Lab to experiment with CE strategies; this comes from the purpose to transform it on the first circular precinct of Turin. Through the fund of Torino City Lab and EU funds such as Horizon 2020.
	Circoscrizione 2 *(Precinct local authority)* **AMIAT /IREN -** *(Public Company waste/energy)*	The Circoscrizione 2 is the local Mirafiori South Precinct authority; they manage all of the censuses activity of the precinct and the distribution of the funding for local projects, from infrastructure to social aspects. AMIAT /IREN a Public Company that manages the waste/ energy services for the city and Mirafiori South precinct. In particular, they are a relevant stakeholder as the precinct counts with an incinerator facility which plays an essential role in the waste and energy supply for the city and the precinct.

Table 5.4 Mirafiori South precinct Stakeholder analysis scheme

and comprehensively applied an infographic tool to elaborate visualisations. The role of the researcher (designer) was as a mediator between Mirafiori South precinct complex data and the stakeholders, translating the given information into an efficient and straightforward visual language through infographic maps or giga-maps.

The interpretation phase (Figure 3.3) delivered holistic construction of the Mirafiori South precinct, enabling in-depth analysis through establishing connections among the data presented on each infographic map. Furthermore, visualisation allowed the interpretation of the Mirafiori South precinct, data's flows, as well as relational factors, encouraging an overview of the existing relationships between the components and processes (Figure 3.8).

The interpretation also involved the participation of the lead stakeholders who elaborate along with the researcher a further analysis of the complex scenario, integrating all feedback. The interpretation of Mirafiori South precinct oversees the system's criticalities to achieve circularity beyond the immediate cause but from a broader perspective of how it can be addressed from a systemic point of view

URBAN FABRIC

The data collection around the urban fabric category was focused on morphological features and natural resources having special attention on existing infrastructure, urban voids and public services (with a focus on quantity)(Figure 5.35). The precinct is contained in a peri urban area with a total surface of 11,491 km^2. The area is divided into the following areas (Figure 5.36):

- *Cemetery;* characterized for a extend graveyard park and incinerator facility.
- *FIAT;* characterized for concentrate most industrial infrastructure.
- *Borgata Mirafiori;* the location of the old borough and historical sites
- *Colonnetti Park;* characterized for concentrate most social housing, community services, small shops and commerce of the district is concentrated.

These sectors reveal the morphology of this precinct which was planned initially as Garden city (De Filippi & Vassallo, 2016), this can be seen on the distribution of the public space, industry, housing and public services. The Mirafiori South precinct is surrounded by a considerable belt of green areas between nature reserves and agricultural areas. Moreover, the fact that the Sangone river delimits its borders has given the district a network of naturalistic pathways. There is a considerable extension of public greenery with like Colonnetti and Piemonte public park. The urban biodiversity and local ecosystem are connected by greenery present on the most crucial mobility corridors such as Corso Agnelli, Settembrini, Unione Sovietica or via Plava. However, this has created a lack of accessibility from the east side inhabitants to the west side greenery. Also, this has created perceived insecurity in green areas. (Figure 5.35)

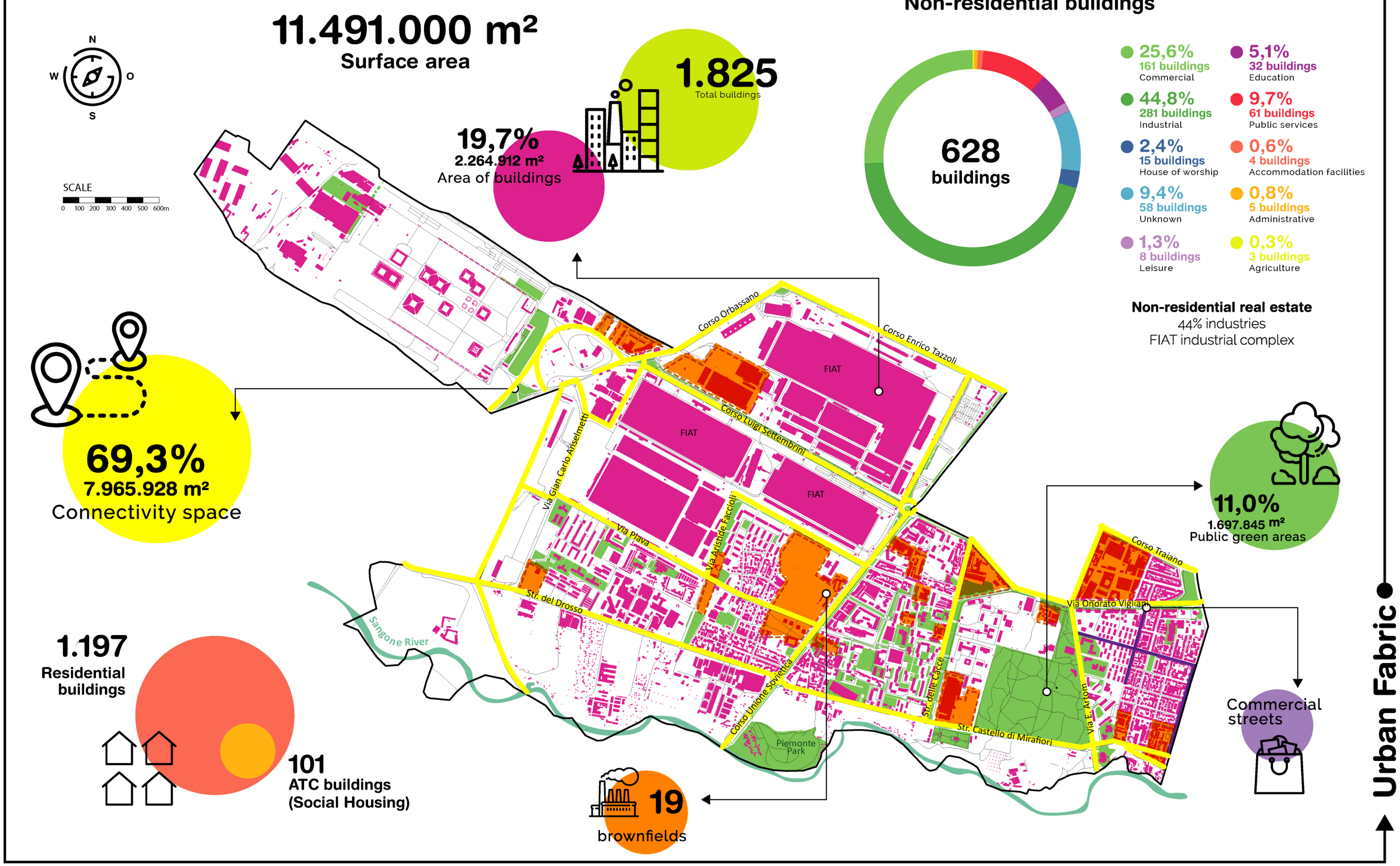
At levels of infrastructure, there is a low temperature, reduction of heat island effect thanks to the excellent relationship between green areas and density of the building—moreover, the vast spaces on highway infrastructure help to avoid traffic congestion associated peaks of air pollution.

As a result, this resembles on the mobility components which give priority to the private vehicle use area (significant extensions of FIAT Parking area), there is a lack of public transport connectivity and scarce cycling infrastructure inside the precinct—creating a sense of isolation (ghetto) in the precinct due to accessibility (Figure 5.36).

The analysis of the built environment enables to see the vast extension of the land occupied by FIAT and the urban voids part of the ex-industrial areas revealing the challenges and disconnection between the services of the district and the rise of brownfields and polluted areas. Moreover, it also reveals the considerable amount of social housing which subsequently expanded and finally downsized. The

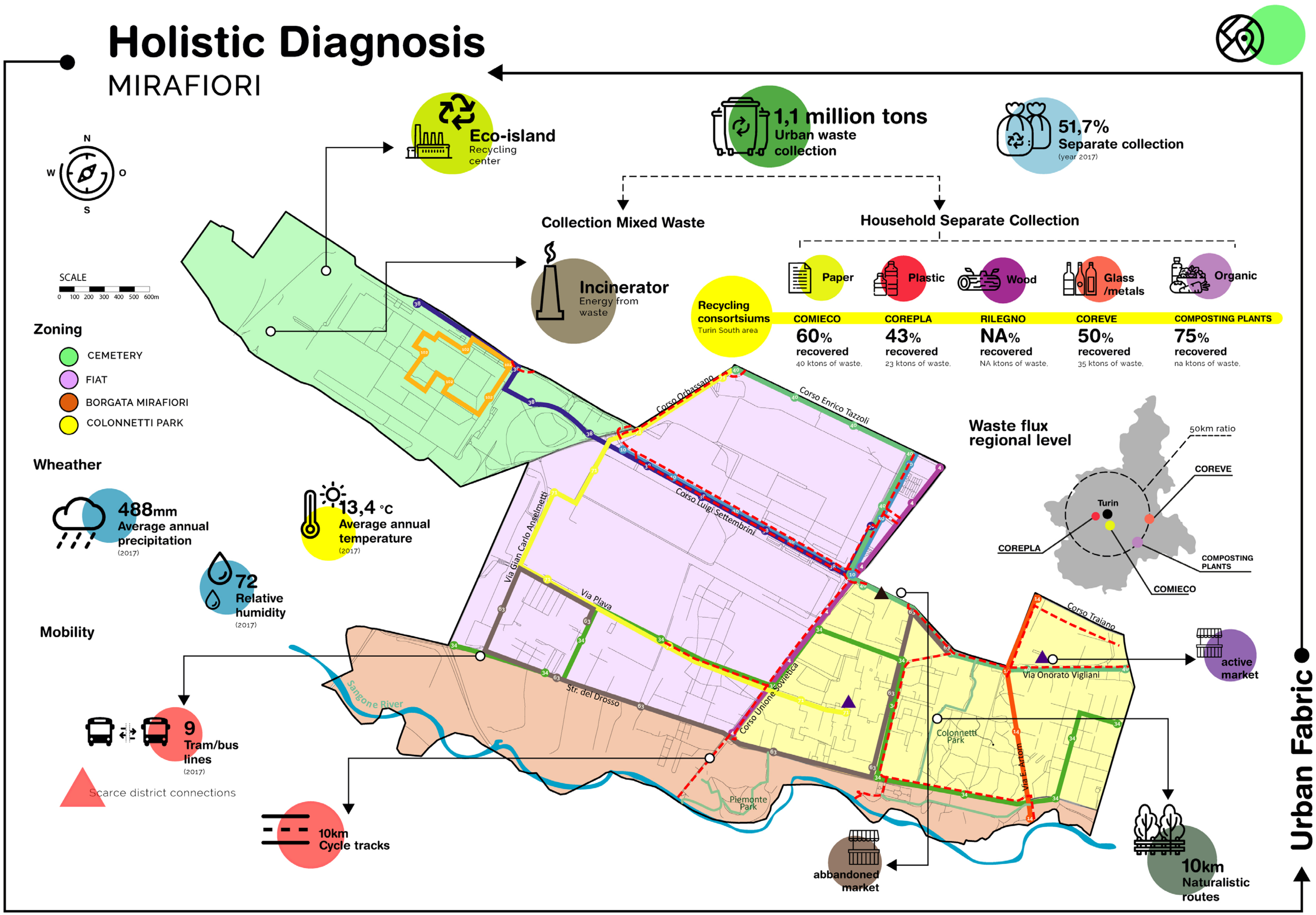
Figure 5.35 Mirafiori South Holistic Diagnosis Urban Fabric part I
Figure 5.36 Mirafiori South Holistic Diagnosis Urban Fabric part II

Holistic Diagnosis
MIRAFIORI



Source: Annex I

Holistic Diagnosis
MIRAFIORI



Source: Annex I

decline of the precinct it reflected in its real estate prices for rent and sale, which are the lowest in the city.

Nowadays, only 30% of the total industrial complex of FIAT is in operations, identifying the deployed and active areas. As a result, many of the social welfare infrastructures such as schools, universities, markets, libraries, and social housing quality average have been shut down or abandoned.

On regards, the household waste management almost 50% gets into a proper waste separation infrastructure for households. In particular, two facilities strongly influence waste management in the area are; the presence of an Eco-island to recycle appliances and electronic material (serves all Turin South) and the waste incinerator (which serves all Turin). In particular, the incinerator not only arises considerably the emission of the neighbourhood but also there is very little awareness on regards wastes management on the precinct due to its dominant role, as residents think that all of their waste will go to that facility. The data showed that most of the household waste travels a ratio of 50 km to be processed. Most data on the recycling came from the consortiums that provided the total amounts for the South Turin. (Figure 5.36)

Concerning food security, even though this precinct is a peri-urban area with huge potential, there is no local supply of products. Over the years there have been initiatives to promote km 0 as local markets these have continually failed because of price and supply, making residents do groceries on the few supermarkets of the area or other neighbourhoods.

DEMOGRAPHY

The demography section described the state-of-the-art of the Mirafiori as workers' precinct par excellence (Figure 5.37)(Figure 5.38). Specifically, it presented the consequences of the radical changes in their population from high levels migration in the 1950s from southern Italy to the diaspora crisis of FIAT in the 80s the transformation of the social fabric over the years, reflected on the current population growth rate.

The district presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems and a strong cultural mix, physically isolated and socially separated from the surrounding areas. At the same time, this condition gave a strong sense of belonging to the inhabitants of the area character that still tries to survive in the third sector associations.

From the sociotechnical perspective, the analysis delivered radiography of the post-industrial society of Mirafiori. This phenomenon has reflected on a decline of the population density in almost 50% since 1970. Consequently, this has reflected on the high rates of adult and elderly, which represent 60 % of the total population. The young population are at high risk of school dropout, due to the degradation of the precinct which high risk of exclusion and poverty.

A key factor on the territory as leverage for change is the presence of a vital student community contained on the network of 10 schools, the Politecnico di Torino (Mirafiori campus) and University of Turin (chemistry faculty). They have brought a considerable student community along with universitarian residences that aim to change the social and economic dynamics of the area (Figure 5.37).

The economic crisis of the precinct has brought a socio-economic degradation, and social cohesion challenges especially among the vulnerable population: migrants, homeless and refugees Especially this precinct is characterized for having dismantled a ROM camp .

The public services and infrastructure are a well-served area, has across 27 facilities of public services between (libraries, theatres, community centres, two University campus, ten schools infrastructures etc.)- however, Some of these has been shut down.

Figure 5.37 Mirafiori South Holistic Diagnosis Demography part I

Figure 5.38 Mirafiori South Holistic Diagnosis Demography part II

Holistic Diagnosis

MIRAFIORI

Population

871.810
Turin
habitants

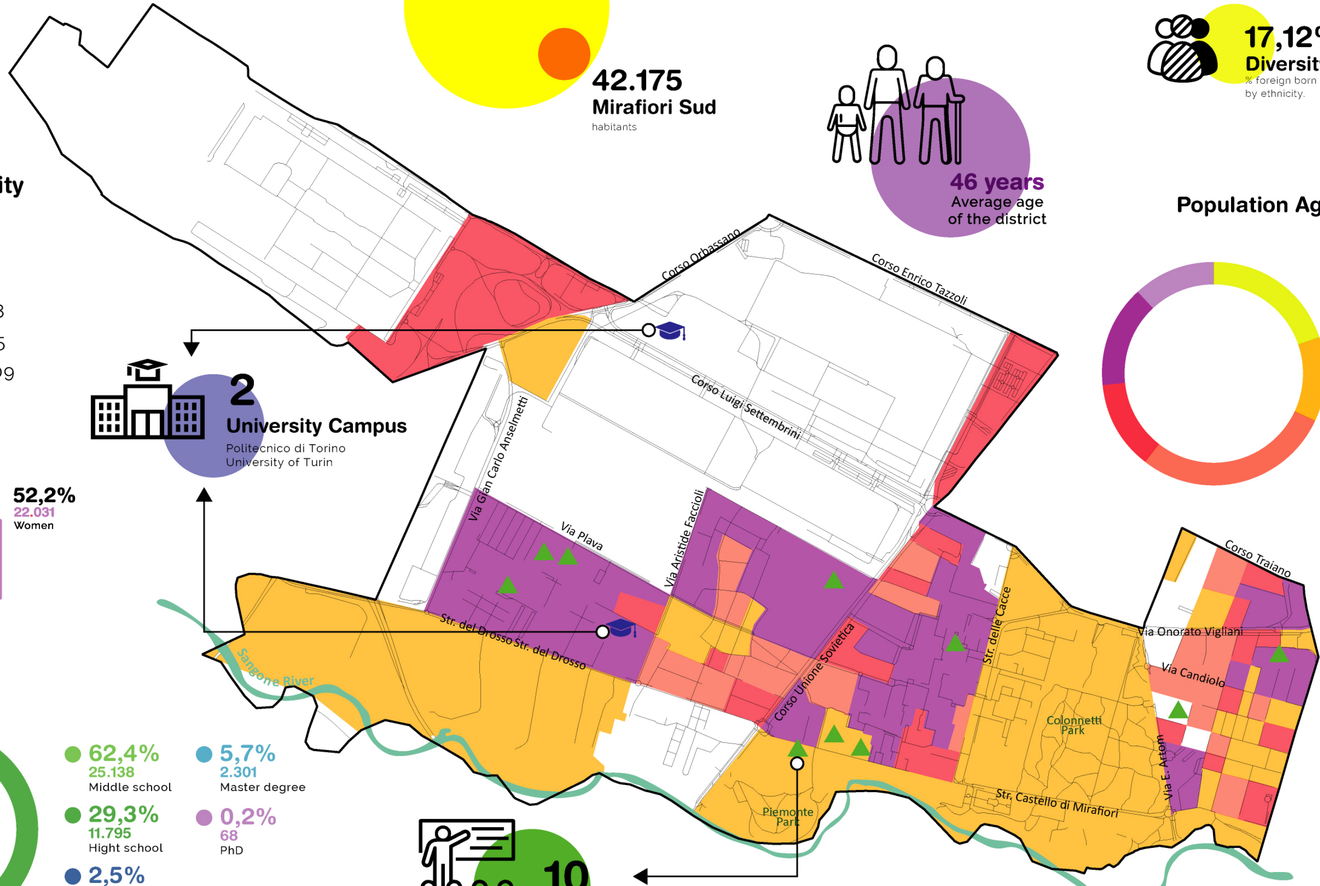
42.175
Mirafiori Sud
habitants

-3,59% (2018)
Migration rate
Net number of migrants per 1.000 population.

-0,86% (2018)
Population grow rate
Average annual rate of change of population size (%)

17,12% (2011)
Diversity statistics
% foreign born residents. population by ethnicity.

46 years
Average age of the district



Population density (absolute value)

- 0 - 11
- 11 - 140
- 140 - 298
- 298 - 525
- 525 - 1209

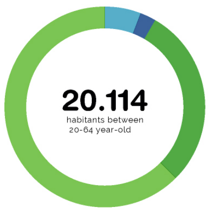
2
University Campus
Politecnico di Torino
University of Turin

Gender Balance

47,8%
20.144
Men

52,2%
22.031
Women

Educational level



- **62,4%** 25.138 Middle school
- **29,3%** 11.795 Hight school
- **2,5%** 1.008 Bachelor's degree
- **5,7%** 2.301 Master degree
- **0,2%** 68 PhD

10
School Buildings

Population Age ranges

- **11,7%** < 14 years
- **14,7%** 15 - 30 years
- **12,8%** 31 - 40 years
- **28,7%** 41 - 60 years
- **12,1%** 61 - 70 years
- **19,9%** > 70 years

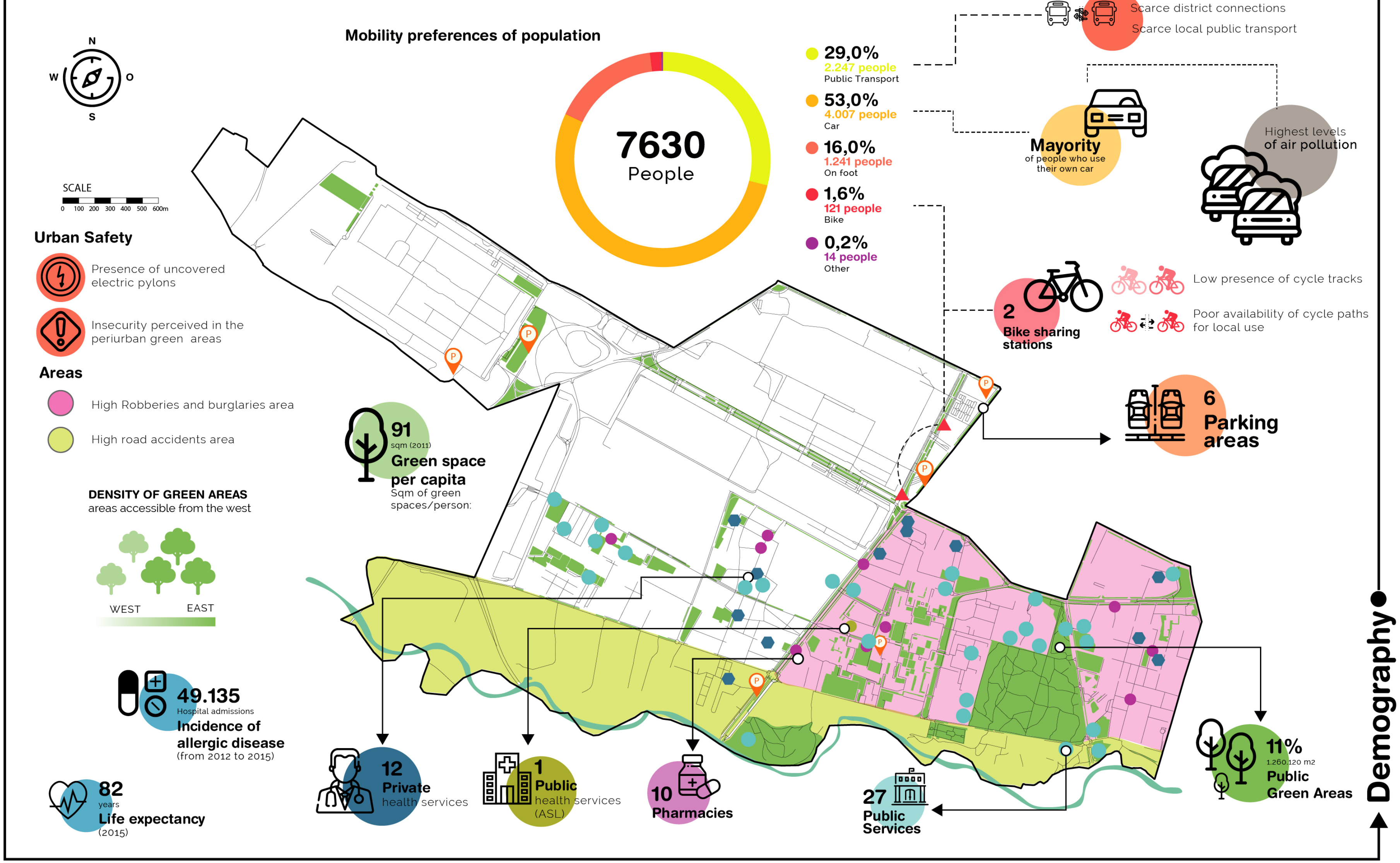
24.779
Employed Population
Between 15-64 years

Demography

Source: Annex I

Holistic Diagnosis

MIRAFIORI



Source: Annex I

As mentioned in the urban fabric section due to the lack of connectivity with public transport and prevalence of good highway connections the local population has a preference for commuting in the private car than public transport (lack of accessibility).

On regards, the health indicators, the incidence of allergic diseases are related to respiratory disease due to the high levels of pollution in the area. Most health facilities still operate; however, due to the decrease of the population, residents have to look for assistance in other precincts.

ECONOMY

The economic indicators are evidence of how the precinct has transitioned from a Fordist economic model and to an attempt of economic diversification. The abandonment of FIAT as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. As a result, numerous urban voids on the precinct show a progressive depletion industrial and residential buildings and the reduced commercial activities. (Figure 5.39)

Among the 2732 companies from multinationals to entrepreneurial activity, other sectors have emerged in the district beyond FIAT. Notably, most companies are classified as Individual company or only one-person company, even though this shows that the precinct entrepreneurial spirit of this business does not scale hampering employment. Even though the presence of FIAT is still significant as an employer of the area, the types of jobs were forced to diversify on the decline of the automobile sector with single man enterprises. (Figure 5.39)

On relation to local commerce, they have a long tradition embedded in the local culture. However, there are remarkably few local shops compared to the city average low number of local business units, as the precinct population has decreased local commerce struggles to keep activity. The high rates of Unemployment on the area also influence the diaspora of young people and the scarce settling of new families into the precinct.

On the manufacturing side, there are still 130 enterprises on the sectors Metal & Engineer, Plastics, Food, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and engineer Consultancy. The most significant is the 47 Metal & Engineer companies which are related to the manufacture and repair of car parts. However, industrial waste has a different stream which differs on each type of industry. Most of this waste goes out of the precinct and is not connected to other industries or local activities (i.e. significant food waste amount from canteens). Moreover, the industrial waste data provided by the Turin Chamber of Commerce of Turin, allowed to visualized that the typologies of industrial waste have the potential for synergies in local activities or industries. Still, as shown in the (Figure 5.40), the quantities are not available to the public only the type of waste products by the major industrial sectors in the precinct.

The total population employed in Mirafiori South precinct is 24.779 (between 15-64 years), most of their skills are in Retail, Construction and electronics. However, the companies based in Mirafiori South they employ a total of more than 139,000 employees, this means that companies outsource skills mainly from outside of the precinct.

On regards the economic reactivation the presence of TNE is relevant as an intervention company with predominantly public capital, established to implement these former disused industrial areas become fertile ground for the creation of new urban redevelopment opportunities through the reindustrialization and establishment of service activities. Still, there is a low interaction between the development plans of the TNE area and the local community. Currently, the government is promoting a new plan to industrialize the area, bringing automotive and aerospace industry again.

Figure 5.39 Mirafiori South Holistic Diagnosis Economy part I
Figure 5.40 Mirafiori South Holistic Diagnosis Economy part II

Figure 5.41 Mirafiori South Holistic Diagnosis Culture part I

Holistic Diagnosis

MIRAFIORI

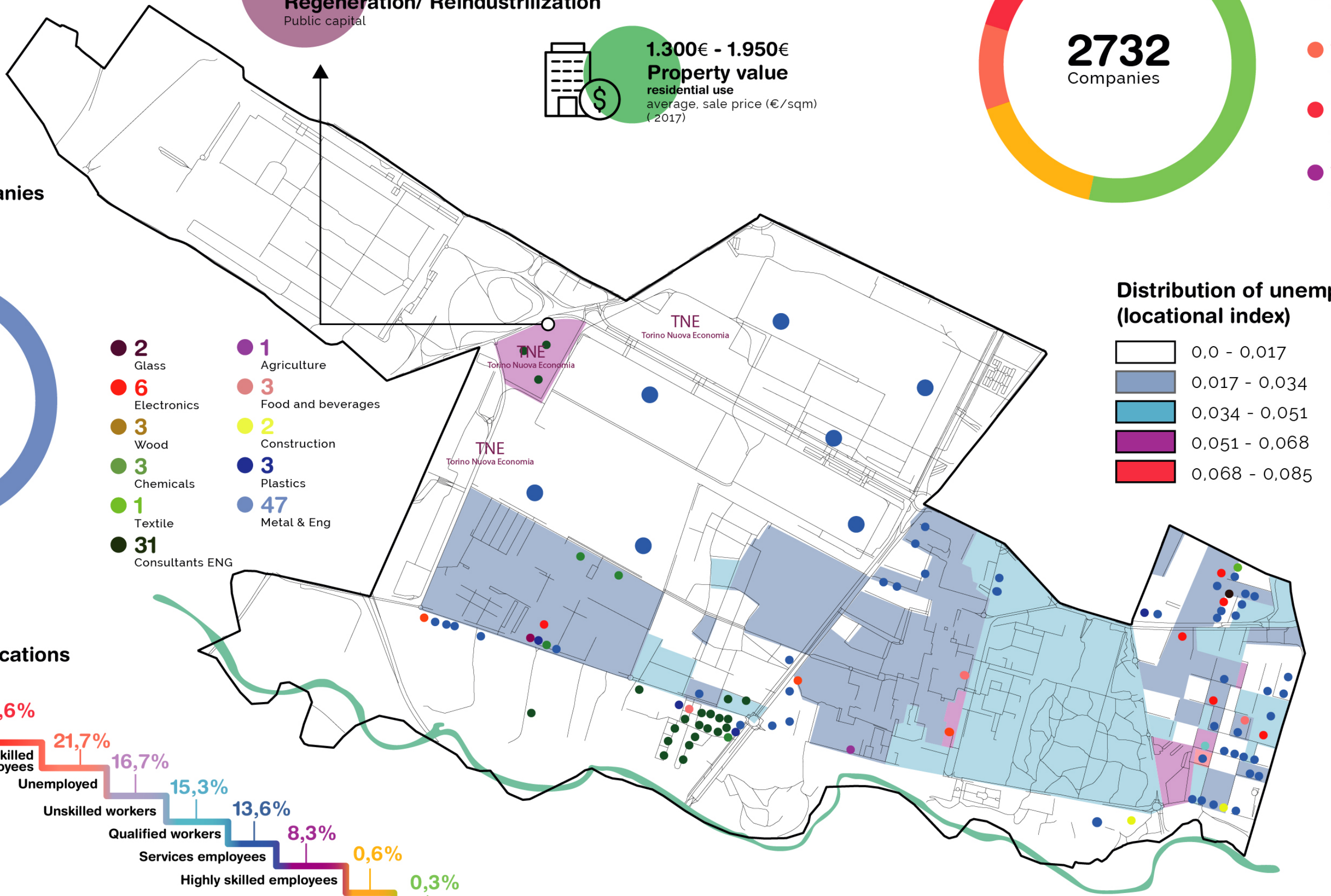
N
W O
S

SCALE
0 100 200 300 400 500 600m

TNE - Turin New Economy
Intervention company
Regeneration/ Reindustrilization
Public capital

700€ - 1.400€
Property value
commercial/industrial/office
average, sale price (€/sqm)
(2017)

1.300€ - 1.950€
Property value
residential use
average, sale price (€/sqm)
(2017)



Type Of Companies

2732
Companies

- **53,6%** 1465 companies — Individual company
- **16,2%** 442 companies — Limited liability company
- **10,1%** 276 companies — Limited partnerships
- **7,7%** 211 companies — General partnership
- **12,4%** 338 companies — Other

Manufacture companies

(2019)

- **2** Glass
- **6** Electronics
- **3** Wood
- **3** Chemicals
- **1** Textile
- **31** Consultants ENG
- **1** Agriculture
- **3** Food and beverages
- **2** Construction
- **3** Plastics
- **47** Metal & Eng

Distribution of unemployed (locational index)

- 0,0 - 0,017
- 0,017 - 0,034
- 0,034 - 0,051
- 0,051 - 0,068
- 0,068 - 0,085

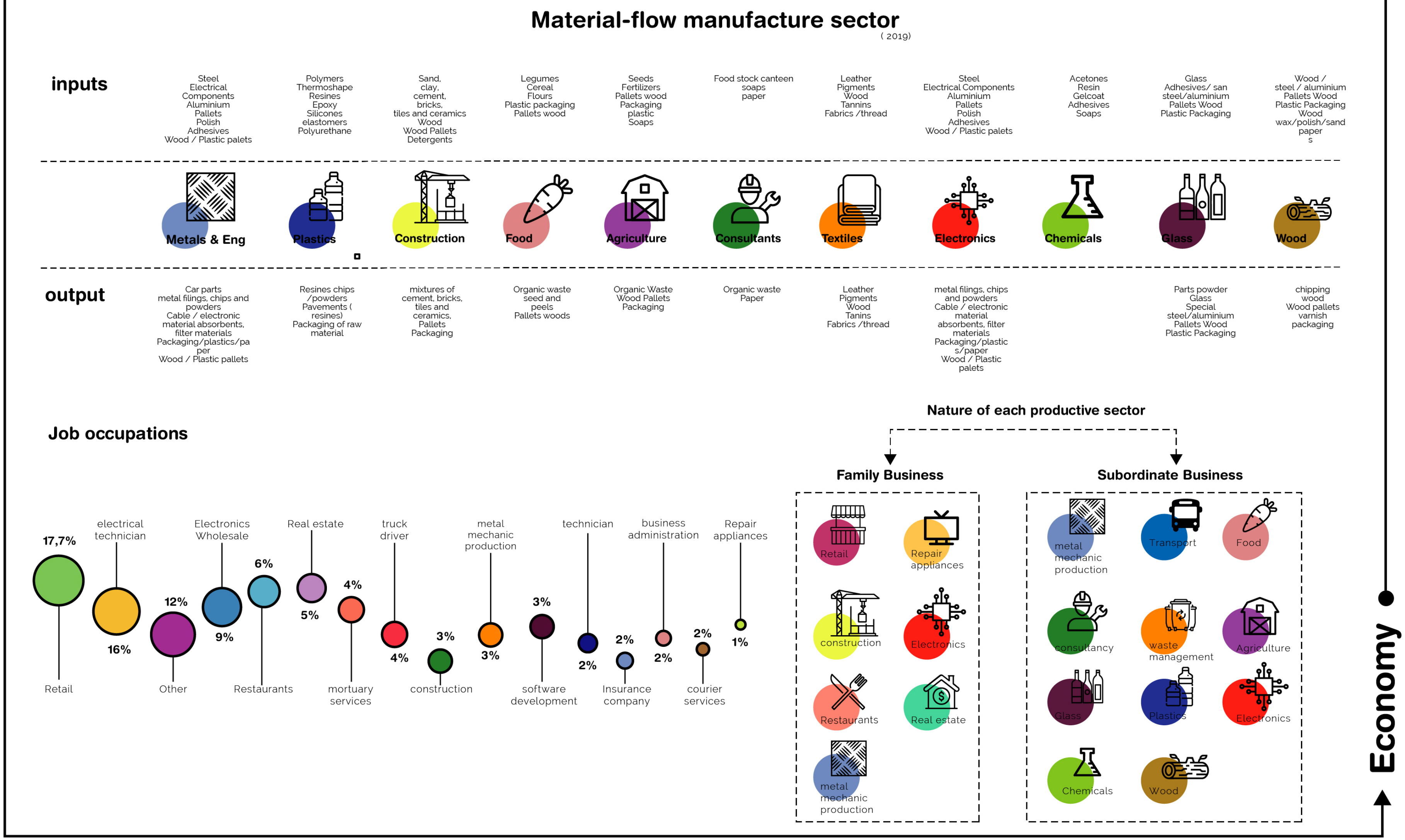
Employment qualifications

23,6%
Average skilled employees
21,7%
Unemployed
16,7%
Unskilled workers
15,3%
Qualified workers
13,6%
Services employees
8,3%
Highly skilled employees
0,6%
Military
0,3%
Farmers

Economy

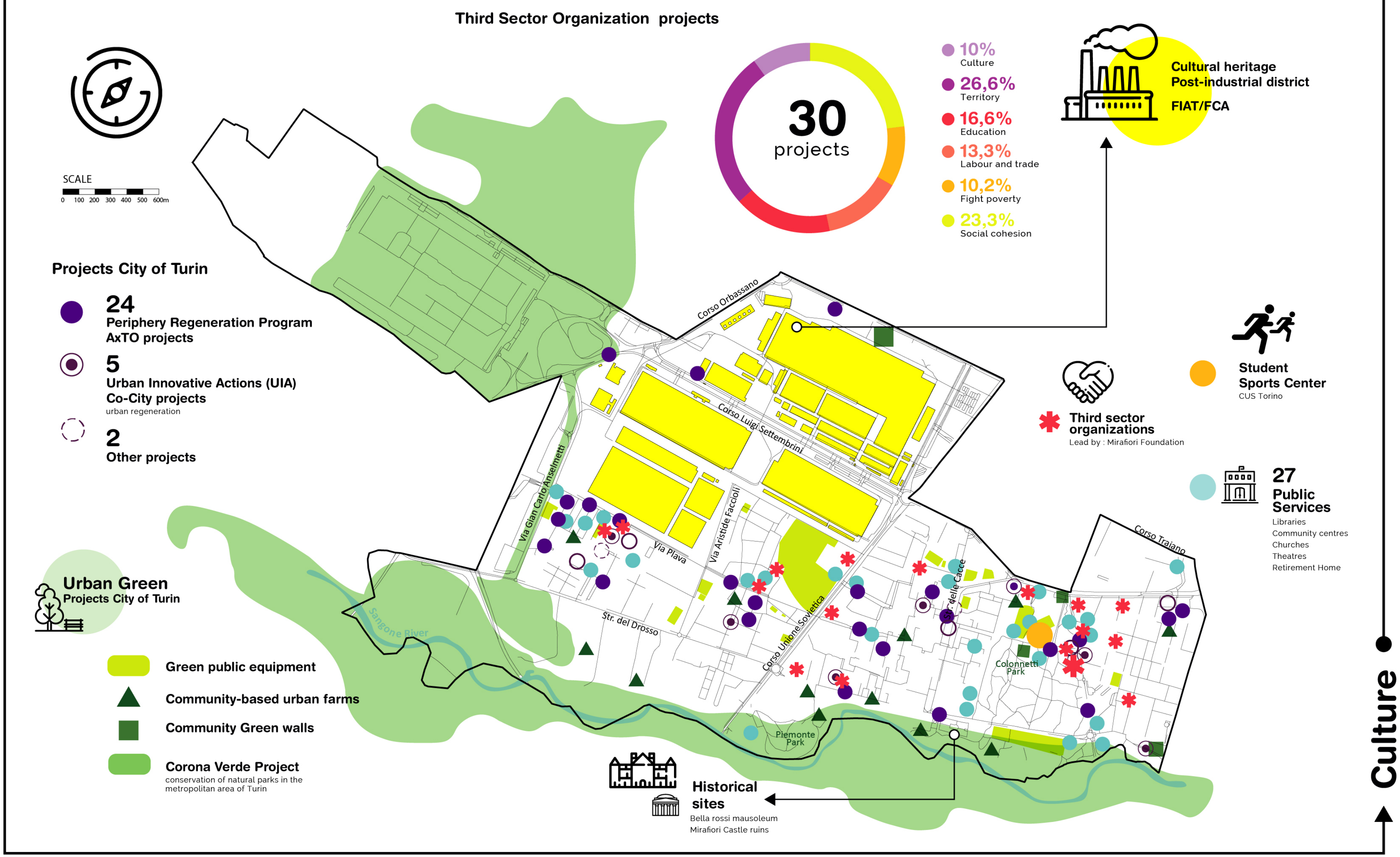
Source: Annex I

Holistic Diagnosis
MIRAFIORI



Source: Annex I

Holistic Diagnosis
MIRAFIORI



Source: Annex I

Moreover, it is essential to highlight the increasing role of the third sector as a potential force of local economic reactivation, promoting local businesses and social enterprises, creating a resilient local economic ecosystem.

CULTURE

Given the historical background of this precinct shall be approached as Post-industrial cultural heritage site.The precinct's history represents the cultural influence of FIAT, shaping all aspects from the urban fabric to demographic and economic (Figure 5.41).
The current cultural agenda has been promoted by a strong influence of the Third sector actors over 30 organizations working on the precinct. These organizations are promoting the conservation of the cultural heritage and new urban identities to arouse on one side reflection and sense of belonging by the inhabitants; on the other hand, interest, and attraction for the territory by the city of Turin and beyond the municipal boundaries; implement inclusive and participatory local initiatives. As historical working-class precinct, the sense of belonging has been a constant over the years, making a very active community despite the current challenges of depopulation and increasing ageing bring much influence from south Italy's influence. (Figure 5.41).

On regards the architecture heritage since the '90s, different urban regeneration projects were promoted to preserve and enhance the urban fabric and cultural heritage sites, to give a new image to the district. Therefore, some historical sites such as the ruins of Mirafiori Castle - Mausoleum of la Bella Rossin - Old Mirafiori Village. Nevertheless, despite the vast amount of resources and expertise invested, they have always reached rather modest outcomes. There still an evident lack of awareness of these historical heritage sites (Figure 5.41).

Another focus on post-industrial architecture heritage is located on the industrial dismissed areas of FIAT, which should be treated as Post Industrial Heritage sites . Most of these post-industrial sites are mostly empty warehouses, which have the potential for local economic and social purposes. Other assets such as the social housing from the 1960's is part of the architectonic heritage could turn into key point to promote local culture. Last but not least, the been a peri urban area the present has been influenced by traditional agricultural practices. Moreover, urban greenery has been utilized widely as a tool of social cohesion (Garden city model)

5.5 Definition of problems & leverages

As previously explained in section 4.7.1 to reach a Circular City model, it is necessary to overview the local assets of Mirafiori South precinct critically, in order to target the local assets that could serve as potential levers and activate a systemic transition towards circularity and value creation. For this framework on post-industrial precincts, was defined two criteria of assessment of Local Assets Potential Levers; Opportunity as value creation and Challenge as value creation.

This stage addressed every local lever of Mirafiori South in order to support a system transition towards a Circular City model. Furthermore, this stage also has in consideration Table 5.3 analysis of the Policy Framework Analysis, where it identified the current levers policies & projects that could support future CE strategies on a Circular City model.

The Table 5.5 is part of the research synthesis of the previous visualization phase, presenting a critical overview of the local assets, in order to target the local assets that could serve as potential levers for circularity. Moreover, it highlights the holistic challenges issues in Mirafiori South precinct that hamper circularity but could represent an opportunity (challenges into opportunities). At the same time also creates awareness in opportunities that foster a Circular City model inside the precinct. So , as a result there is a shared understanding of the current levers presents on Mirafiori South that could support future CE strategies on a Circular City model.

Table 5.5 Mirafiori South precinct analysis of Local Assets Potential Levers

	OPPORTUNITY AS VALUE CREATION	CHALLENGE AS VALUE CREATION
urban fabric	-The precinct located in a Peri-Urban Area near a natural reserve / Agricultural area -Parks extended to the south with good ecological potential. Potential climate adaptation. -Area design on a Garden city model. A higher percentage of "green per capita". The precinct has a considerable presence of green areas and perceived as green. -Low temperature, reduction of heat island effect thanks to the good relationship between green areas and density of the building -Large spaces that help to avoid traffic congestion associated peaks of air pollution. -Industrial Urban Voids / Empty Infrastructure available public buildings -A high number of public spaces / civic commons. -Presence of Flat roofs and residual urban spaces /potential -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -Presence of cycle paths that connect the district to the city centre. Potential to improve commuting. -Empty Social Housing/ High concentration of social housing. Potential for new economic/social purpose -A high percentage of industrial infrastructure -A high percentager of waste separation infrastructure for households -Presence of Incinerator: energy generator. Potential for synergies with households and industry. -Presence of an Eco-island to recycle appliances (a facility for Turin South).	-Insecurity perceived in the vast green areas. -Lack of accessibility of Green areas from all areas of the precinct. -Predominant parking areas, some underutilized -19 Abandoned industrial - Underutilized - connections voids in the precinct. -Brownfields Urban soils with high levels of pollutants. -Presence of abusive gardens on degraded and polluted area -Scarce district public transport connections.Commuting limitations,- Isolated precinct due to accessibility - (is not an area attractive to visitors) -Food accessibility- local markets struggle /potential for urban peri-urban agriculture) -Absence of pedestrian areas, areas of safe access to the school and areas with limited traffic -Low presence of Cycling lanes - commuting limitation. -A high concentration of underutilized social housing/ghetto -Presence of the incinerator affects the waste separation on the precinct. -Household waste travels processed (recycled) on a ratio 50km.
demography	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -CSR companies to involve the employees of companies based in Mirafiori. -27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure.	-The decline of the population/ scarce increase of new generations -Low interaction between the industry/local community. Presence of marginal groups: ROM camp / homeless shelters -Preference for commuting in a private car than public transport (lack of accessibility. -Closure of public services (last years)/ empty public buildings/ -Decline outdoor local market activity. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: migrants, homeless, refugees, -High rates of adult and elderly Population -Lack of job opportunities for the local population, -The incidence of allergic diseases is related to respiratory disease due to the high levels of pollution.
economy	-The shops and commerce of the district are concentrated in 2 main roads. Potential for new economic/social synergies. -Not predominant manufacture sector (significant) -Predominant Metal and engineering companies (a significant amount of car repair workshops) . 47 companies which are related to the manufacture and repair of car part -Circular Business; 3 Business on Repair appliances -Circular Business;Construction waste process company -Lowest prices of real estate on the City -TNE - the presence of public companies for reindustrialization/ regeneration. -Opportunity for circular investors. -Local (commerce) business, long tradition. Potential for new economic/social -Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and engineer Consultancy -The total population employed in Mirafiori precinct is 24.779 (between 15-64 years), most of their skills are in Retail, Construction and electronics sectors.	-Socio-economic degradation (Economic crisis of the area has brought unemployment -Only one person company do not promote flourishing employment -Few local shops compared to the city average Low number of local business units -Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct. -Low interaction between the development plans of the TNE area and the former Mirafiori factory/local community. -Companies outsource skills mainly from outside of the precinct. -Industrial waste not connected to local activities (i.e Significant food waste amount from canteens and local markets)
culture	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons. -Post Industrial Heritage sites/empty FIAT warehouses. -Potential for new economic/social purposes -Traditional agricultural practices. Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose -Historical sites such as the ruins of Mirafiori Castle - Mausoleum of La Bella Rossin - Old Mirafiori Village. Potential for new economic/social purposes -A strong presence of Third Sector/across different fields economy- social - environment -Local (commerce) business, long tradition (butchery, ice cream-maker, bakery) -A strong sense of belonging, working-class precinct. -A historical working-class precinct, a milestone on the Italian manufacture history the first "Fordist City".	-Post Industrial Heritage sites / empty FIAT warehouses. -Decreased of generalized participation (i.e. the decline of church participation) -Loneliness, relational isolation from the elderly population (retired FIAT workers that still live in the area). -Lack of awareness on the historical heritage . -Lack of awareness on the value of post-industrial sites.

5.6 Design the system & Circular City model

After reaching synthesis of all local asset levers of the Mirafiori South precinct, in this phase, the researcher addressed the results of Table 5.5 and Table 5.3 (Policy Framework analysis) through a co-design approach asses them to identify and co-create of the circular city actions proposed in (Figure 4.5) (see section 4.7.1).

As optimisation and localise actions are mandatory prerequisites for all Circular Actions to happen (Figure 4.5), the framework should be approached firstly identifying the Main Circular Actions and subsequently, the supporting actions. According to this, the Co-Design Session Round table intended to identify the Mirafiori South precinct levers that can support the Main Circular Actions (looping, regenerating and adapting).

CO-DESIGN SESSION ROUNDTABLE

As described in section (4.7.1), the roundtable discussion involved a group of the identified the “lead stakeholders” (Table 5.4) such as; City of Turin Department of Innovation and Smart City (government), Chamber of Commerce (industries), Mirafiori Foundation (communities) and Politecnico di Torino (research institutions). Other attendants (i.e. FCA- Fiat Chrysler Automobile, Public Schools Network, Circoscrizione 2 Mirafiori South Precinct authority, and AMIAT /IREN a Public Company for waste/energy services). The purpose was to bridge between the Local Assets /Potential Levers (HD maps - Figure 5.35-41) of the precinct and the Main Circular Actions, following a quadruple helix dynamic.

The roundtable session was carried as an engaging event,’ (Meroni et al., 2013), stakeholders were invited by the City of Turin Department of Innovation and Smart City to the session conducted at city hall facilities. On 16th April 2019.

The objective of this gathering was to present the outcomes of the Local Assets /Potential Levers (Table 5.5)(HD maps - Figure 5.35-41) and co-design the identification of the assets that can support the Main Circular Actions and subsequently the supporting actions. The following steps and tools where executed :

1. *Set up:* Registration process and setting up the roundtable.

2. *Introduction:* Introduce the findings of the study (HD maps - Figure 5.35-41, Local Assets / Potential Levers, Main Circular Actions). (Figure 5. 42)

Figure 5.42 Round table session Mirafiori South Stakeholders I

3. *Circular Actions Co-Design:* The participants provided further feedback on the presented HD maps - Figure 5.35-41, Local Assets /Potential Levers. Afterwards, the participants altogether were asked to outline which identified Local Assets / Potential Levers could support the Main 3 Circular actions (Loop/ Regenerate / Adapt) in order to facilitate implementation on Mirafiori South. (Figure 5.43 -44)

4. *Final Discussion:* The discussion was open to the audience, to welcome additional feedback and enrich the framework.

This forum was not only designed to provoke the participants to identify assets in each circular action but also meant to serve the stakeholders think the assets of the Mirafiori South Precinct holistically. In order to establish circular actions that create value and are resilient over time. The roundtable discussion allowed sharing needs and offerings (in order to optimise the use of the local assets and levers) as well as an opportunity for building future collaborations on circular strategies. Through the roundtable discussion, the researcher also intended to make straightforward her role and responsible practice, based on open communication with the stakeholders.

The discussion was documented via photo, and the data captured at the session are reflected in Table 5.6, which approaches the Local Assets/ Potential Levers supporting Main Circular Actions and Table 5.7. represents the Policy Framework supporting Main Circular Actions.

The outcomes of this analysis are presented a re-design of the current system based on the conceptualisation of a Systemic approach on Circular City framework, targeting the precinct levers (challenges and opportunities)by single or several Circular Actions. This critical approach intended to reframe Mirafiori South local levers in relation to the Circular City framework, in order to corroborate and enrich the framework and identify recommendations for further enquiry.ocal levers in relation to the Circular City framework.

Figure 5.43 Round table session Mirafiori South Stakeholders I I

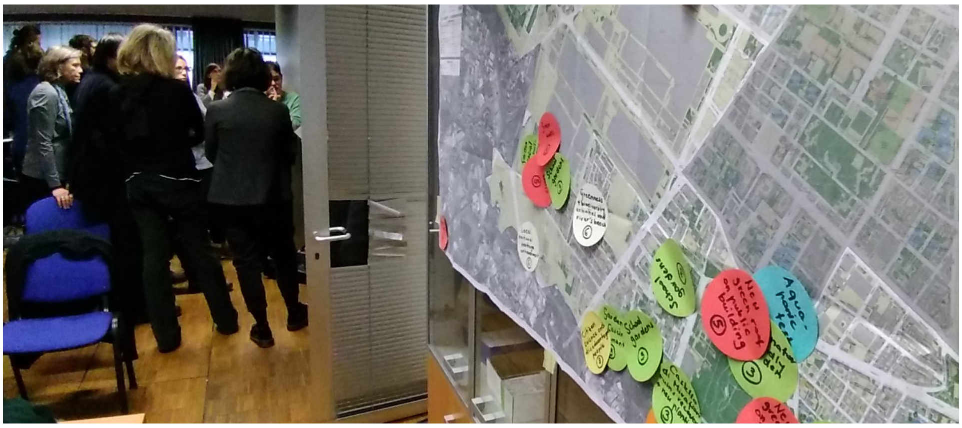


Figure 5.44 Round table session Circular Actions Co-Design material

Table 5.6 Mirafiori South precinct analysis Local Assets Potential Levers supporting Main Circular Actions R:Regenerate A:Adapt L:Loop

	OPPORTUNITY AS VALUE CREATION	R	A	L	CHALLENGE AS VALUE CREATION	R	A	L
urban fabric	The precinct located in a Peri-Urban Area near a natural reserve / Agricultural area	x	x	x	Insecurity perceived in the vast green areas.		x	
urban fabric	Parks extended to the south with good ecological potential. Potential climate adaptation.	x			Lack of accessibility of Green areas from all areas of the precinct.	x	x	
urban fabric	Area design on a Garden city model. A higher percentage of "green per capita". The precinct has a considerable presence of green areas and perceived as green.	x			Predominant parking areas, some underutilized		x	
urban fabric	Low temperature, reduction of heat island effect thanks to the good relationship between green areas and density of the building	x	x		19 Abandoned industrial - Underutilized - connections voids in the precinct.		x	x
urban fabric	Large spaces that help to avoid traffic congestion associated peaks of air pollution.	x			Brownfields Urban soils with high levels of pollutants.		x	x
urban fabric	Industrial Urban Voids / Empty Infrastructure available public buildings	x	x	x	Presence of abusive gardens on degraded and polluted area	x		
urban fabric	A high number of public spaces/civic commons.		x		Scarce district public transport connections. Commuting limitations,- Isolated precinct due to accessibility - (is not an area attractive to visitors)		x	
urban fabric	Presence of Flat roofs and residual urban spaces /potential	x	x		Food accessibility- local markets struggle/ potential for urban peri-urban agriculture)	x		x
urban fabric	Presence of 2 University campus (Available infrastructure)	x	x		Absence of pedestrian areas, areas of safe access to the school and areas with limited traffic		x	
urban fabric	Presence of 10 schools. (Available infrastructure)	x	x		Low presence of Cycling lanes - commuting limitation.		x	
urban fabric	Presence of cycle paths that connect the district to the city centre. Potential to improve commuting.		x		A high concentration of underutilized social housing/ghetto		x	x
urban fabric	Empty Social Housing/ High concentration of social housing. Potential for new economic/ social purpose		x		Presence of the incinerator affects the waste separation on the precinct.			x
urban fabric	A high percentage of industrial infrastructure		x		Household waste travels processed (recycled) on a ratio 50km.			x
urban fabric	A high percentager of waste separation infrastructure for households			x				
urban fabric	Presence of Incinerator: energy generator. Potential for synergies with households and industry.			x				
urban fabric	Presence of an Eco-island to recycle appliances (a facility for Turin South).			x				
demography	A presence of a strong network on active community involvement programmes.	x	x	x	The decline of the population/ scarce increase of new generations	x		x
demography	Presence of schools and university student community.	x		x	Low interaction between the industry/local community.		x	x
demography	A strong presence of the Third sector and social cohesion initiatives.	x	x	x	Presence of marginal groups: ROM camp / homeless shelters	x		x
demography	CSR companies to involve the employees of companies based in Mirafiori.	x	x	x	Preference for commuting in a private car than public transport (lack of accessibility)		x	
demography	27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure.	x	x		Closure of public services (last years)/empty public buildings/Decline outdoor local market activity.		x	
demography					Socio-economic degradation (Economic crisis of the area has brought Unemployment).	x	x	x
demography					Social Cohesion challenges with vulnerable population: migrants, homeless, refugees,	x	x	x
demography					High rates of adult and elderly population	x		x
demography					Lack of job opportunities for the local population,			x
demography					The incidence of allergic diseases is related to respiratory disease due to the high levels of pollution.	x		
	The shops and commerce of the district are concentrated in 2 main roads. Potential for new economic/social synergies.			x	Socio-economic degradation (Economic crisis of the area has brought unemployment		x	x
	Not predominant manufacture sector (significant)			x	Only one person company do not promote flourishing employment		x	x
	Predominant Metal and engineering companies (a significant amount of car repair workshops) 47 companies which are related to the manufacture and repair of car part			x	Few local shops compared to the city average Low number of local business units		x	x

OPPORTUNITY AS VALUE CREATION	R	A	L
Circular Business; 3 Business on Repair appliances			x
Circular Business;Construction waste process company			x
Lowest prices of real estate on the City		x	
TNE - the presence of public companies for reindustrialization/ regeneration. Opportunity for circular investors.		x	x
Local (commerce) business, long tradition. Potential for new economic/social		x	x
Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and engineer Consultancy			x
The total population employed in Mirafiori precinct is 24.779 (between 15-64 years), most of their skills are in Retail, Construction and electronics sectors.			x
culture			
Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons.	x	x	x
Post Industrial Heritage sites / empty FIAT warehouses. Potential for new economic/social purposes		x	x
Traditional agricultural practices.	x		
Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose	x	x	
Historical sites such as the ruins of Mirafiori Castle - Mausoleum of la Bella Rossin - Old Mirafiori Village. Potential for new economic/ social purposes	x	x	
A strong presence of Third Sector /across different fields economy- social - environment	x	x	x
Local (commerce) business, long tradition (butchery, ice cream-maker, bakery)			x
A strong sense of belonging, working-class precinct.	x	x	x
A historical working-class precinct, a milestone on the Italian manufacture history the first "Fordist City".		x	x

CHALLENGE AS VALUE CREATION	R	A	L
Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct.	x		x
Low interaction between the development plans of the TNE area and the former Mirafiori factory/ local community.		x	x
Companies outsource skills mainly from outside of the precinct.			x
Industrial waste not connected to local activities (i.e Significant food waste amount from canteens and local markets)			x
culture			
Post Industrial Heritage sites / empty FIAT warehouses.		x	x
Decreased of generalized participation (i.e. the decline of church participation)	x		x
Loneliness, relational isolation from the elderly population (retired FIAT workers that still live in the area).	x		
Lack of awareness on the historical heritage .		x	
Lack of awareness on the value of post-industrial sites.		x	x

urban fabric

TOP-DOWN	R	A	L
Urban Regeneration program Mirafiori (1996 - 2004)	x	x	
Torino Metropoli 2025	x	x	
Metropolitan Strategic Plan 2018-2020	x	x	
Urban program ,2001 (regeneration strategy)	x	x	
Corona Verde Project	x		
Municipal Waste Management Regulations of the City of Turin (2003- 2019)			x
Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	x	x	x
Piedmont Regional Law 24/2002 - Rules for waste management			x
Piedmont Provincial Waste Management Program (PPGR 2010)			x
ProGireg H2020 : Nature Based Solutions for post-industrial cities	x	x	

BOTTOM-UP	R	A	L
Mira up project	x	x	
Piazza raggazabile project	x	x	
Mirafiori Bike Tour project	x		
Orti Generali project	x		x

	TOP-DOWN	R	A	L	BOTTOM-UP	R	A	L
demography	AxTo - Action for the periphery of Turin/ Project Alloggiami: Co-housing project		x		Casa nel Parco project	x		x
demography	Urban Innovative Actions (UIA) Co-City - urban commons /socio-spatial polarisation Urban poverty (2017 - 2020)		x		Una casa per tutti project			x
demography	FIAT Corporate Social Responsibility program	x		x	Essere Anziani project			x
demography					2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events	x		
demography					5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.	x		
economy	TNE (Turin New Economy) intervention company	x	x	x	Mirafiori Solidale project	x		x
economy	National Reindustrialization Programme (2019)		x		Vetrina per Mirafiori project			x
economy	PLANET APP – Mirafiori Sud	x			Coprogettazione commercio project	x		x
economy	National law n.134 of 2012 "support and development of electrical requalification"		x		Fa bene project		x	x
economy					Carota project			x
culture	Torino City Lab project	x	x	x	Mirafiori non spereca project		x	x
culture	Mirafiori Cultura in Circolo;/ Mirafiori Culture in a Circle project			x	Mirafiori social Green project	x	x	x
culture					Il quartiere al museo project		x	
culture					Mirafiori dopo il mito		x	

Table 5.7 Mirafiori South precinct analysis Policy Framework supporting Main Circular Actions R:Regenerate A:Adapt L:Loop

5.7 Outcomes Evaluation

The roundtable discussion inspired further opportunities to emerge on what policies and assets of the Mirafiori South precinct can be levers to activate strategies towards a Circular City model. Considering these outcomes, this part of the examination intended to identify concrete CE strategies inside the Mirafiori South precinct (Figure 4.6). For each action was established the type of potential/ executed strategies and described in separate tables:

- *Regenerate*: green walls (Table 5.8), regenerate soil (Table 5.9), urban farming (Table 5.10), pollinator biodiversity (Table 5.11), aquaponics (Table 5.12)

- *Adapt:* reuse infrastructure (Table 5.13), retrofitting infrastructure (Table 5.14), flexible infrastructure/community (Table 5.15)

- *Loop:* recycle (Table 5.16), reuse (Table 5.17), energy recover (Table 5.18).

The tables refined the main Circular Actions into targeted strategies for value creation in Mirafiori South precinct. The purpose of this examination was to understand what actions more local levers could have involved to be activated in order to propose the following implementation stage. On that perspective, it will deliver an overview of what actions could activate al Circular City model dynamic in Mirafiori South precinct.

REGENERATE STRATEGY - GREEN WALLS		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Urban Regeneration program Mirafiori (1996 - 2004) -Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -Urban program ,2001 (regeneration strategy) -ProGireg H2020 project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-Low temperature, reduction of heat island effect thanks to the good relationship between green areas and density of the building -Large spaces that help to avoid traffic congestion associated peaks of air pollution. -Presence of Flat roofs and residual urban spaces /potential -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure)
demography	-FIAT Corporate Social Responsibility program -2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events -5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school. -Casa nel Parco project	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -CSR companies to involve the employees of companies based in Mirafiori. -The incidence of allergic diseases is related to respiratory disease due to the high levels of pollution. -Social Cohesion challenges with vulnerable population: migrants, homeless, refugees, -Presence of marginal groups: ROM camp / homeless shelters -The decline of the population/ scarce increase of new generations -27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure.
economy	-PLANET APP – Mirafiori Sud	-TNE - the presence of public companies for reindustrialization/ regeneration. Opportunity for circular investors.
culture	-Torino City Lab project -Mirafiori social Green project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -Decreased of generalized participation (i.e. the decline of church participation) -Traditional agricultural practices. -Social Housing from the 1960s is part of the architectonic heritage. -Potential for new economic/social purpose -Historical sites such as the ruins of Mirafiori Castle - Mausoleum of la Bella Rossin - Old Mirafiori Village. Potential for new economic/social purposes -A strong sense of belonging, working-class precinct.

Table 5.8 Levers Assessment, Regenerate strategy Green walls Mirafiori South precintc

<REGENERATE STRATEGY - REGENARATE SOIL		
	CURRENT LEVERS POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Urban Regeneration program Mirafiori (1996 - 2004) -Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020 -Urban program ,2001 (regeneration strategy) -ProGireg H2020 project -Orti Generali project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014) -Piedmont Regional Law 24/2002 - Rules for waste management -Piedmont Provincial Waste Management Program (PPGR 2010)	-The precinct located in a Peri-Urban Area near a natural reserve / Agricultural area -Industrial Urban Voids / Empty Infrastructure available public buildings -19 Abandoned industrial - Underutilized - connections voids in the precinct.
demography		-Socio-economic degradation (Economic crisis of the area has brought Unemployment).
economy	-Coprogettazione commercio project	-TNE - the presence of public companies for reindustrialization/ regeneration. Opportunity for circular investors.
culture	-Torino City Lab project -Mirafiori social Green project	-Traditional agricultural practices.

Table 5.9 Levers Assessment, Regenerate strategy Regenerate soil Mirafiori South precinct

REGENERATE STRATEGY - COMMUNITY FARMING		
	CURRENT LEVERS POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -Urban program ,2001 (regeneration strategy) -Corona Verde Project -ProGireg H2020 project -Orti Generali project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-The precinct located in a Peri-Urban Area near a natural reserve / Agricultural area -Parks extended to the south with good ecological potential. Potential climate adaptation. -Area design on a Garden city model. A higher percentage of "green per capita". The precinct has a considerable presence of green areas and perceived as green. -Food accessibility- local markets struggle /potential for urban peri-urban agriculture) -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -Presence of abusive gardens on degraded and polluted area -19 Abandoned industrial - Underutilized - connections voids in the precinct.
demography	-Casa nel Parco project -FIAT Corporate Social Responsibility program -2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events -5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.	-A presence of a strong network on active community involvement programmes. -A strong presence of the Third sector and social cohesion initiatives. -CSR companies to involve the employees of companies based in Mirafiori. -High rates of adult and elderly Population -Social Cohesion challenges with vulnerable population: migrants, homeless, refugees, -Presence of marginal groups: ROM camp / homeless shelters -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure) -Some closed/ empty public infrastructure.
economy	-PLANET APP – Mirafiori Sud	-Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct.
culture	-Mirafiori social Green project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons. -Decreased of generalized participation (i.e. the decline of church participation) -Traditional agricultural practices. -Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose -Historical sites such as the ruins of Mirafiori Castle /Mausoleum of la Bella Rossin - Old Mirafiori Village. -Potential for new economic/social purposes -A strong sense of belonging, working-class precinct.

Table 5.10 Levers Assessment, Regenerate strategy Community farming Mirafiori South precinct

REGENERATE STRATEGY - POLLINATOR BIODIVERSITY		
	CURRENT LEVERS POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Current Levers policies & projects -Urban Regeneration program Mirafiori (1996 - 2004) -Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -Urban program ,2001 (regeneration strategy) -Corona Verde Project ProGireg H2020 Project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-Territorial Assets - Potential Levers -The precinct located in a Peri-Urban Area near a natural reserve / Agricultural area -Parks extended to the south with good ecological potential. Potential climate adaptation. -Area design on a Garden city model. A higher percentage of "green per capita". The precinct has a considerable presence of green areas and perceived as green. -Large spaces that help to avoid traffic congestion associated peaks of air pollution. Presence of Flat roofs and residual urban spaces /potential Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -Presence of cycle paths that connect the district to the city centre. Potential to improve commuting. -19 Abandoned industrial - Underutilized - connections voids in the precinct. -Lack of accessibility of Green areas from all areas of the precinct.
demography	-Casa nel Parco Project -FIAT Corporate Social Responsibility program -2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events -5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.	A presence of a strong network on active community involvement programmes. Presence of schools and university student community. A strong presence of the Third sector and social cohesion initiatives. CSR companies to involve the employees of companies based in Mirafiori. The incidence of allergic diseases is related to respiratory disease due to the high levels of pollution. Social Cohesion challenges with vulnerable population: migrants, homeless, refugees, Presence of marginal groups: ROM camp / homeless shelters 27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure.
culture	-Torino City Lab Project -Mirafiori social Green Project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -Decreased of generalized participation (i.e. the decline of church participation) -Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose -Historical sites such as the ruins of Mirafiori Castle - Mausoleum of la Bella Rossin - Old Mirafiori Village. Potential for new economic/social purposes -A strong sense of belonging, working-class precinct.

Table 5.11 Levers Assessment, Regenerate strategy Pollinator Biodiversity Mirafiori South precinct

Table 5.12 Levers Assessment, Regenerate strategy Aquaponics Mirafiori South precinct

REGENERATE STRATEGY - AQUAPONIC		
	CURRENT LEVERS POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -ProGireg H2020 Project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-Industrial Urban Voids / Empty Infrastructure available public buildings -Food accessibility- local markets struggle /potential for urban peri-urban agriculture) -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -19 Abandoned industrial - Underutilized - connections voids in the precinct. -Lack of accessibility of Green areas from all areas of the precinct.
demography	-Casa nel Parco Project -FIAT Corporate Social Responsibility program -2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events -5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -CSR companies to involve the employees of companies based in Mirafiori. -High rates of adult and elderly Population -Social Cohesion challenges with vulnerable population: migrants, homeless, refugees, -Presence of marginal groups: ROM camp / homeless shelters.
economy	- PLANET APP – Mirafiori Sud	-Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct.
culture	-Torino City Lab Project -Mirafiori social Green Project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -Decreased of generalized participation (i.e. the decline of church participation) -Traditional agricultural practices. -Loneliness, relational isolation from the elderly population (retired FIAT workers that still live in the area). -A strong sense of belonging, working-class precinct.

Table 5.13 Levers Assessment, Adapt strategy Retrofitting infrastructure Mirafiori South precinct

ADAPT STRATEGY - RETROFITTING INFRASTRUCTURE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Urban Regeneration program Mirafiori (1996 - 2004) -Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -Urban program ,2001 (regeneration strategy) -Mira up Project -Piazza raggazabile Project -ProGireg H2020 Project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-The precinct located in a Peri-Urban Area near a natural reserve / Agricultural area -Parks extended to the south with good ecological potential. Potential climate adaptation. -Area design on a Garden city model. A higher percentage of "green per capita". The precinct has a considerable presence of green areas and perceived as green. -Low temperature, reduction of heat island effect thanks to the good relationship between green areas and density of the building -Large spaces that help to avoid traffic congestion associated peaks of air pollution. -A high number of public spaces / civic commons. -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -Empty Social Housing/ High concentration of social housing. Potential for new economic/social purpose -A high percentage of industrial infrastructure -Predominant parking areas, some underutilized -19 Abandoned industrial - Underutilized - connections voids in the precinct.
demography	-AxTo - Action for the periphery of Turin/Project Alloggiami -Urban Innovative Actions (UIA) Co-City - urban commons /socio-spatial polarisation Urban poverty (2017 - 2020) -Casa nel Parco Project	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure. -Low interaction between the industry/local community.
economy	-National Reindustrialization Programme (2019) -PLANET APP – Mirafiori Sud -National law n.134 of 2012 "support and development of electrical requalification"	-Lowest prices of real estate on the City -TNE - the presence of paublic companies for reindustrialization/ regeneration. Opportunity for circular investors. -Local (commerce) business, long tradition. Potential for new economic/ social
culture	-Torino City Lab project	Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose

Table 5.14 Levers Assessment, Adapt strategy Reuse Infrastructure Mirafiori South precinct

ADAPT STRATEGY - REUSE INFRASTRUCTURE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -Urban program ,2001 (regeneration strategy) -Mira up Project -Piazza raggazabile Project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-Parks extended to the south with good ecological potential. Potential climate adaptation. -Area design on a Garden city model. A higher percentage of "green per capita". The precinct has a considerable presence of green areas and perceived as green. -Low temperature, reduction of heat island effect thanks to the good relationship between green areas and density of the building -A high number of public spaces / civic commons. -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -Empty Social Housing/ High concentration of social housing. Potential for new economic/social purpose -A high percentage of industrial infrastructure -Predominant parking areas, some underutilized -19 Abandoned industrial - Underutilized - connections voids in the precinct. -Brownfields Urban soils with high levels of pollutants.
demography	-AxTo - Action for the periphery of Turin/Project Alloggiami -Urban Innovative Actions (UIA) Co-City - urban commons /socio-spatial polarisation Urban poverty (2017 - 2020)	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure. -Low interaction between the industry/local community. -Closure of public services (last years)/ empty public buildings/ Decline outdoor local market activity.
economy	-National Reindustrialization Programme (2019) -PLANET APP – Mirafiori Sud	-Lowest prices of real estate on the City -TNE - the presence of public companies for reindustrialization/ regeneration. Opportunity for circular investors. -Local (commerce) business, long tradition. Potential for new economic/ social
culture	-Torino City Lab project -Mirafiori social Green project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -Post Industrial Heritage sites / empty FIAT warehouses. -Potential for new economic/social purposes -Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose -Historical sites such as the ruins of Mirafiori Castle - Mausoleum of la Bella Rossin - Old Mirafiori Village. Potential for new economic/social purposes -A strong sense of belonging, working-class precinct.

Table 5.15 Levers Assessment, Adapt strategy Flexible Infrastructure and Community Mirafiori South precinct

ADAPT STRATEGY - FLEXIBLE INFRASTRUCTURE AND COMMUNITY		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Urban Regeneration program Mirafiori (1996 - 2004) -Torino Metropoli 2025 -Metropolitan Strategic Plan 2018-2020, -Urban program ,2001 (regeneration strategy) -Mira up Project -Piazza raggazabile Project -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014)	-Parks extended to the south with good ecological potential. Potential climate adaptation. -Large spaces that help to avoid traffic congestion associated peaks of air pollution. -A high number of public spaces / civic commons. -Presence of Flat roofs and residual urban spaces /potential -Presence of 2 University campus (Available infrastructure) -Presence of 10 schools. (Available infrastructure) -Empty Social Housing/ High concentration of social housing. Potential for new economic/social purpose -A high percentage of industrial infrastructure -Absence of pedestrian areas, areas of safe access to the school and areas with limited traffic
demography	-AxTo - Action for the periphery of Turin/Project Alloggiami -Urban Innovative Actions (UIA) Co-City - urban commons /socio-spatial polarisation Urban poverty (2017 - 2020) -Casa nel Parco Project	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -27 facilities of public services between (libraries, theatres, community centres.. etc.) (Available infrastructure).Some closed/ empty public infrastructure. -Low interaction between the industry/local community. -Closure of public services (last years)/ empty public buildings/ Decline outdoor local market activity.
economy	-TNE (Turin New Economy) intervention company -PLANET APP – Mirafiori Sud -Fa bene Project -Carota Project	-Circular Business;Construction waste process company -Lowest prices of real estate on the City -TNE - the presence of public companies for reindustrialization/ regeneration. Opportunity for circular investors. -Local (commerce) business, long tradition. Potential for new economic/ social -Few local shops compared to the city average Low number of local business units -Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct.

	ADAPT STRATEGY - FLEXIBLE INFRASTRUCTURE AND COMMUNITY	
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
culture	-Torino City Lab project -Mirafiori social Green project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -Post Industrial Heritage sites / empty FIAT warehouses. -Potential for new economic/social purposes -Social Housing from the 1960s is part of the architectonic heritage. Potential for new economic/social purpose -Historical sites such as the ruins of Mirafiori Castle - Mausoleum of la Bella Rossin - Old Mirafiori Village. Potential for new economic/social purposes -A strong presence of Third Sector /across different fields economy-social - environment -A strong sense of belonging, working-class precinct.

	LOOP STRATEGY - RECYCLE	
	CURRENT LEVERS POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Torino Metropoli 2025 -Waste Management Program ;door collection to door (2003- 2019) -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014) -Piedmont Regional Law 24/2002 - Rules for waste management -Provincial Waste Management Program (PPGR 2010	-19 Abandoned industrial - Underutilized - connections voids in the precinct. -A high number of public spaces / civic commons. -A high percentager of waste separation infrastructure for households -Presence of an Eco-island to recycle appliances (a facility for Turin South). -Brownfields Urban soils with high levels of pollutants. -Household waste travels processed (recycled) on a ratio 50km.
demography	-Casa nel Parco Project -Una casa per tutti Project -Essere Anziani Project -2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events -5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -CSR companies to involve the employees of companies based in Mirafiori. -Low interaction between the industry/local community. -Presence of marginal groups: ROM camp / homeless shelters -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: migrants, homeless, refugees. -Lack of job opportunities for the local population,
economy	-PLANET APP – Mirafiori Sud -Mirafiori Solidale Project -Vetrina per Mirafiori Project -Coprogettazione commercio Project -Fa bene Project -Carota Project	- The shops and commerce of the district are concentrated in 2 main roads. Potential for new economic/social synergies. -Not predominant manufacture sector (significant) -Predominant Metal and engineering companies (a significant amount of car repair workshops) . 47 companies which are related to the manufacture and repair of car part -Circular Business; 3 Business on Repair appliances Circular Business;Construction waste process company Local (commerce) business, long tradition. Potential for new economic/ social -Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and engineer Consultancy -The total population employed in Mirafiori precinct is 24.779 (between 15-64 years), most of their skills are in Retail, Construction and electronics sectors. -Only one person company do not promote flourishing employment -Few local shops compared to the city average Low number of local business units -Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct. -Companies outsource skills mainly from outside of the precinct. -Industrial waste not connected to local activities (i.e Significant food waste amount from canteens and local markets)
culture	-Torino City Lab Project -Mirafiori non spereca Project -Mirafiori Cultura in Circolo;/ Mirafiori Culture in a Circle -Mirafiori social Green Project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -A strong sense of belonging, working-class precinct.

Table 5.16 Levers Assessment , Loop strategy Recycle Mirafiori South precinct

LOOP STRATEGY - REUSE		
	CURRENT LEVERS POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Torino Metropoli 2025 -Waste Management Program ;door collection to door (2003- 2019) -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014) -Piedmont Regional Law 24/2002 - Rules for waste management -Provincial Waste Management Program (PPGR 2010	-A high percentager of waste separation infrastructure for households -Presence of an Eco-island to recycle appliances (a facility for Turin South). -Household waste travels processed (recycled) on a ratio 50km.
demography	-Casa nel Parco Project - Una casa per tutti Project - Essere Anziani Project - 2 Youth community centers for the youth for teaching on crafts/ homeworks/ repair/ cultural events -5 Afters school projects: this third sector initiatives were related to activities for promoting social cohesion and community related activities after school.	-A presence of a strong network on active community involvement programmes. -Presence of schools and university student community. -A strong presence of the Third sector and social cohesion initiatives. -CSR companies to involve the employees of companies based in Mirafiori. -Low interaction between the industry/local community. Presence of marginal groups: ROM camp / homeless shelters -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: migrants, homeless, refugees, -High rates of adult and elderly Population -Lack of job opportunities for the local population
economy	-PLANET APP – Mirafiori Sud -Mirafiori Solidale Project -Vetrina per Mirafiori Project -Coprogettazione commercio Project -Fa bene Project -Carota Project	-The shops and commerce of the district are concentrated in 2 main roads. Potential for new economic/social synergies. -Not predominant manufacture sector (significant) -Predominant Metal and engineering companies (a significant amount of car repair workshops) . 47 companies which are related to the manufacture and repair of car part -Circular Business; 3 Business on Repair appliances Circular Business;Construction waste process company -Local (commerce) business, long tradition. Potential for new economic/ social -The total population employed in Mirafiori precinct is 24.779 (between 15-64 years), most of their skills are in Retail, Construction and electronics sectors. -Companies outsource skills mainly from outside of the precinct. -Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct.
culture	-Torino City Lab project -Mirafiori social Green project -Mirafiori non spereca Project -Il quartiere al museo Project -Mirafiori Cultura in Circolo;/ Mirafiori Culture in a Circle. -Mirafiori dopo il mito Project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -A strong presence of Third Sector /across different fields economy-social - environment -A strong sense of belonging, working-class precinct. -Decreased of generalized participation (i.e. the decline of church participation)

Table 5.17 Levers Assessment , Loop strategy Reuse Mirafiori South precinct

LOOP STRATEGY - ENERGY RECOVERY		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Torino Metropoli 2025 -National law n.134 of 2012 "support and development of electrical requalification" -Waste Management Program ;door collection to door (2003- 2019) -National law n.134 of 2012 "support and development of electrical requalification" -Legislative Decree 152/2006 - Environmental regulations in force since 12/11/2014) -Piedmont Regional Law 24/2002 - Rules for waste management -Provincial Waste Management Program (PPGR 2010	-Presence of Flat roofs and residual urban spaces /potential -A high percentager of waste separation infrastructure for households -Presence of Incinerator: energy generator. Potential for synergies with households and industry. -Household waste travels processed (recycled) on a ratio 50km.
demography	-Casa nel Parco Project	-A presence of a strong network on active community involvement programmes. -CSR companies to involve the employees of companies based in Mirafiori. -Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Lack of job opportunities for the local population,

Table 5.18 Levers Assessment, Loop strategy Energy recovery Mirafiori South precinct

LOOP STRATEGY - ENERGY RECOVERY		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
economy	-PLANET APP – Mirafiori Sud	-Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and engineer Consultancy -Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct. Companies outsource skills mainly from outside of the precinct. Industrial waste not connected to local activities (i.e Significant food waste amount from canteens and local markets)
culture	-Torino City Lab project -Mirafiori social Green project	-Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons . -Local (commerce) business, long tradition (butchery, ice cream-maker, bakery) -A strong sense of belonging, working-class precinct. -Decreased of generalized participation (i.e. the decline of church participation)

5.8 Implementation

After overviewing what policies and assets of the Mirafiori South precinct are levers to activate strategies towards a Circular City model, this stage of the research focused on establish system dynamics through concrete implementations for each strategy of the main Circular Actions (as explained in section 4.7.1). According to the time-Based Design approach, the implementations of the main Circular Actions allowed comprehending the system dynamics (Figure 4.7). To achieve that each strategy was analysed according to the procedure established in (Table 4.4) through implementation, status (executed, planed, implementation) and cross-cutting action, in the following (Table 5.19)(Table 5.20)(Table 5.21).

The analysis of the main Circular Actions implementations will be followed by a research synthesis of the Localize and Optimize Circular Actions within the Mirafiori South precinct. Lastly, a brief description of the role of supportive actions the Mirafiori South precinct.

REGENERATE STRATEGIES

According to the table Table 5.19 the regeneration strategies identified are being mostly executed or planned across the precinct. In this particular case, the levers and the evidence on the precinct presented that the Regenerate Circular Action is one of the most consolidated:

- *Green Walls:* This strategy is starting to spread out as localized pilots from homeless shelters, schools and public infrastructure. It actively involves a broader range of community members aiming to develop a participatory process and co-management for the maintenance of the green infrastructure. Most of these future implementations comes from public funding and partnerships with the third sector and education (Research).

- *Regenerate Soil:* The new soil production is targeted to loop a local resource through a circular business model. This strategy actively involves industry and government aiming to develop a new circular business model that also can benefit the community and natural environment through the creation of an area of “urban forest”. This implementation is funded by public and private funding and partnerships with education (Research).

- *Community urban farming:* This strategy is one with the most numerous implementations and widespread from schools, historical sites, public buildings, public housing and community centres. These strategies actively include a wide variety of community members involving the strong sense of belonging, striving to promote a participatory process and co-management for the maintenance of the urban farms and create awareness on food security. This future implementation comes from public funding and partnerships with the third sector and education (Research).

REGENERATE					
STRATEGY	IMPLEMENTATION	DESCRIPTION	STAKEHOLDERS	STATUS	CROSS-CUTTING ACTIONS
Green Walls	**Green wall at homeless shelter**	Outdoor self-supporting green wall, with removable trays and felt pockets. Participatory design process and co-management for the mantainence of the green walls with the users.	Government Third Sector	Planed	adapt
	Green Wall at school.	Green indoor wall with removable tray system. Participatory processes and co-management for the mantainence of the green walls with the students and the school staff.	Government Education/ Research	Planed	adapt
	Green roof at abbadoned building	Realization of an extensive green roof abbadoned old market building	Government Third Sector	Planed	adapt
	Green roof at Casa nel Parco	Green roofs on third sector /public buildings Locations	Government Third Sector	Planed	adapt
Regenarate Soil	**New Soil production in Sangone Park**	Creation of an area of "urban forest" along the banks of the Sangone through the use of regenerated soil (New Soil), based on aggregates and compost from FORSU and innovative biostimulants.	Government Industry Education	Planed	loop
Community urban farming	**School garden in box**	Realization or integra-tion of educational gardens and scientific laboratories aimed at pri-mary and highschools.	Education/ Research Third Sector	Executed	adapt / loop/ sharing
	Gardens in Cascina Piemonte	Collective gardens rented to individual citizens, common educational area for training and association activities	Third Sector	Executed	adapt / loop
	Pollinator friendly gardens	Box gardens and beehives at abbadoned old market building	Government Third Sector	Executed	adapt / loop/ sharing
	Micro vegetable gardens in schools	Supply of a stock of wood cassettes for the realization of "micro-garden" and composters for schools and practical course for teachers.	Education/ Research	Planed	adapt / loop/ sharing
	Community school gardens	Vegetable garden in wood boxes (raised bed)	Education/ Research	Executed	adapt / loop/ sharing
	Gardens between houses	Placing of fixed containers for urban horticulture.	Third Sector	Planed	adapt / loop/ sharing
	Castello di Mirafiori ruins recovery gardens	Landscape transforma-tion for enhancement of an area of historical and environmental interest.	Third Sector	Executed	adapt / loop
Pollinator Biodiversity	**Butterfly gardens**	In schools and for disadvantaged people. Realization of training activities on the life of butterflies.	Education/ Research	Executed	adapt
	Transect monitoring	Transect in community gardens .Biomonitoring with the transect method.	Education/ Research	Planed	loop
Acuaponics	**Acuaponics pilot**	Small-scale community - designed aquaponics system, to be set up on an abandoned public site.	Government Education/ Research	Planed	loop

Table 5.19 Implementation, Regenerate strategy Green walls, Regenerate soil ,Community farming, Pollinator Biodiversity, and Aquaponics Mirafiori South precinct

- *Pollinator Biodiversity;* This strategy aims to connect the precinct bringing a corridor of biodiversity species on civic commons and public buildings. It actively involves a broader range of community members aims to develop a participatory process to create awareness on biodiversity impacts on public health and food security. These implementations come from public funding and partnerships with the third sector and education (Research).

- *Aquaponics:* This strategy is poised to be the first aquaponics on abandoned post-industrial sites. The aim is to present the community an alternative of blue/green infrastructure for local food cropping that can be scaled up in various units of post-industrial infrastructure. This strategy actively involves a broader range of community members aims to develop a participatory process to create awareness on blue infrastructure and food security. These implementations come from public funding and partnerships with education (Research).

Overall implementation of regeneration strategies is starting to be integrated across the precinct, to restore natural ecosystems and reinforce the sense of belonging and to cope with future climate change effects. The aim is to influence future city plans to ensure residents will have good access to green infrastructures and areas with high recreational and conservation values which have mental and physical health benefits. The introduction of blue-green infrastructure into Mirafiori South precinct will create jobs associated with maintenance, conservation and recreational strategies. The implementation of regeneration strategies will increase biodiversity and vegetation that will reduce air pollution within the Mirafiori South precinct and health impacts.

ADAPT STRATEGIES

According to the table 5.20 the adapt strategies identified are planned or potential across the precinct. Therefore, the levers and the evidence on the precinct presented that the Adapt Circular Actions still need more support to be consolidated:

- *Retrofitting infrastructure:* This strategy aims to reinforce the optimise actions in the precinct, bringing energy efficiency on civic commons and public buildings. These strategies are aimed to have actively involved with community members, industry and government, in order to develop a participatory process to foster energy transition plans. The strategies identified target implementations in public buildings to foster the promotion of a retrofitting circular business model within Mirafiori South precinct. On that way, the retrofitting infrastructure strategy can be scaled up and disseminated through all the precinct infrastructure (industry and housing). Most of these future implementations comes from public funding.

- *Reuse Infrastructure;* This strategy aims to reactivate and connect the underutilised (abandoned) infrastructure precinct such as civic commons public buildings, social housing and post-industrial sites in Mirafiori South. This strategy actively involves community members and industry aiming to develop a participatory process and co-management and maintenance of this deprived infrastructure activating for the new circular activities (social innovation strategies, local businesses NBS strategies, repair Caffe, Public Tool Library). Moreover, these implementations could work as a tool for social cohesion in the Mirafiori South precinct, serving services that fit better the new upcoming community and vulnerable population(Refugees, ROM, migrant, homeless). Most of this future implementation need to be planted in partnerships between government and the third sector.

- *Flexible Infrastructure and Community:* The identified strategies aim to foster the capacity of third sector organisations to generate or enhance local social networks, most of them are currently executed in Mirafiori South precinct. These strategies actively involve a broader range of stakeholders (from community members, industry and Third sector organisations) aiming to make awareness and promote platforms to enhance local culture supporting local platforms (Apps), products and Pop-up events (workshops – festivals) that promote public infrastructures,

ADAPT					
STRATEGY	IMPLEMENTATION	DESCRIPTION	STAKEHOLDERS	STATUS	CROSS-CUTTING ACTIONS
Retrofiting infrastructure	Retrofitting homeless shelter	Retroffiting action with implenting greenwalls on homeles shelters. Outdoor self-supporting green wall, with removable trays and felt pockets.	Government Third Sector	Planed	regenerate
	Retrofitting business model	Implementation of a municipal circular business model for retrofitting implementation on industrial and housing infrastructure. (low real state prices - ideal for bringing investors)	Government Industry	Potential	loop
	Retrofitting public buildings	Retrofitted green roofs and walls and improvements in thermal comfort: Public buildings, social housing and historical infrastructure. Implementation of retrofitting actions facade insulation and renewable sources for heating	Government Third Sector	Planed	regenerate
Reuse Infrastructure	Reuse public infras-tructure	Reuse abandoned or in using public infrastructure such as libraries, home shelters, To encourage Circular Strategies (NBS strategies or social innovation strategies) such as repair, reuse i.e. Public Tool Library).	Government Third Sector	Potential	regenerate/ loop /sharing
	Reuse social housing	Reuse social housing infrastructure that it is suited for social cohesion services that fit better the new upcoming community and vulnerable population. (Refugees, ROM, migrant, homeless). Promote circular strategies; i.e community Urban farming.	Government Third Sector	Potential	regenerate
	Reuse of industrial voids	Reuse of industrial voids to repurpose for local new businesses, engaged with local community, resouces and community heritage. Promote circular business i.e Repair shops.	Government Third Sector	Potential	regenerate/ loop /sharing
Flexible Infrastructrue and Community	Flexible community	Flexible community; a large number of third sector organisations through activities for all population targets (shows capacity to learn, strong social networks for learning, etc.). Enhance local culture).Through periodically Pop-up community events (workshops - festivals) supporting local products heritage or social cohesion. (Schools- Public infrastructures).	Education Third Sector	Executed	regenerate/ loop
	Pop-up events TNE	Pop up events at the TNE (Ex-FIAT wharehouses, fashion shows, street food festivals, symposiums	Government Industry	Executed	loop
	Pop-up events civic commons	Pop events on civic common commercial streets to reinforced the local products industry local food heritage second hand products and exhange practices reuse second hand. The pop-up reuse centre enables residents to recycle repair or swap household items close to their home	Third Sector	Executed	loop , sharing, substitute
	Flexible Social Housing	Adapting housing to create a stronger network of neighbors, through promoting sharing actions. (Communal apps, info about sharing, goods or community services)	Government Third Sector	Planed	regenerate, sharing, substitute
	Events Circular Business model	Circular Business Model to make sustainble and constat the pop activities in the industrial voids	Third Sector	Potential	loop

Table 5.20 Implementation Adapt strategy Retrofitting infrastructure, Reuse Infrastructure, and Flexible Infrastructure and Community Mirafiori South precinct

social housing, civic commons and post-industrial sites. To continually promote such flexibility in the infrastructures, the researcher identified that it could be supported by a circular business model for flexible infrastructures, which ensures stable operation over time. The implementations are solidly backed by sharing actions (discussed in the next section) which foster the social cohesion and resilience among the community. Most of these future implementations comes from partnerships with industry and the third sector.

Overall implementation of adapt strategies for the Mirafiori South precinct requires to integrate on future physical planning, adding long-term robustness and flexibility, in order to be climate, social and economic resilient. Even though there is a significant effort from the Civic Commons Regulation of City of Turin/Regolamento beni comuni, 2019 and TNE area to foster adapt strategies, the precinct is still divided into four different areas by the mostly by post-industrial voids. For that aim, the current urban voids, historical heritage sites and post-industrial infrastructure of Mirafiori South require to be integrated zoning plans which are flexible enough to adapt to a variety of purposes through the year. These strategies reflect the new implemented uses for Mirafiori South precinct infrastructures in order to be resilient must meet today's cultural and economic interests keeping a strong sense of belonging. From that point of view, adapt strategies must foster Mirafiori South precinct into a post-industrial heritage site, such as UNESCO conservation sites.

The strategies foster the adaptive capacity of the Mirafiori stakeholders to be engaged in decision-making processes. In order to generate adapt implementations, all stakeholders must have an understanding of challenges and potential solutions to develop networks through which they can self-organise.

LOOP STRATEGIES

According to the table Table 5.21 the loop strategies identified have a significant executed basis. However, most identified strategies are potential across the precinct. In this particular case, the levers and the evidence on the precinct presented that the Loop Circular Actions still need more support to be consolidated:

- *Recycle:* This strategy has two influential milestones (Municipal separate waste collection and Recycle Education programs/campaigns) which are well established across Mirafiori South precinct. These strategies have actively involved a broader range of community members aiming to develop a participatory process for recycling practices. However, these are strategies that are targeted for household waste and not including the industrial stakeholders. On that view, it was identified as a spectrum of strategies that can include the industrial sector more actively in the recycling strategies of the precinct. These strategies approach from promoting more intends of waste symbiosis between industry, SMEs and recycling consortium, to government incentives for the industry on recycling business models. Most of these future implementations comes from public funding and partnerships with the third sector.

- *Reuse:* Most of the strategies identified are recently started established across the Mirafiori South precinct. These strategies actively involve a broader range of stakeholders (from community members, industry and Third sector organisations) aiming to make awareness and promote platforms to network reuse of products and services present in the Mirafiori South precinct. However, the research identified that there is the potentiality to create repair businesses due to its current manufacture sector potential. These strategies approach from promoting more intends of government incentives to generate new enterprises on a repair business model. Most of these future implementations comes from public funding and partnerships with the third sector.

- *Energy Recovery*: This strategy aims to reinforce the optimise actions in the precinct, bringing energy efficiency. The presence of incinerator influences this strategy, as it is conceived to produce energy from the combustion of inorganic household waste. Promoting a closed-loop (waste-to-energy) system operates across

Table 5.21 Implementation Loop strategy Recycle, Reuse and Energy recovery Mirafiori South precinct

LOOP					
STRATEGY	IMPLEMENTATION	DESCRIPTION	STAKEHOLDERS	STATUS	CROSS-CUTTING ACTIONS
Recycle	Municipal separate waste collection	Municipal separate collection -Glass - Plastic - Organic - Paper sent to recycling consortiums for material recover.	Government	Executed	regenerate
	Recycle Education programs /campaigns	Third Sector organizations involved in the collection of recycling material, education activities to trained and inform the community on circular strategies. Consumers supporting local businesses with house hold waste material for new value chain opportunity.	Government Third Sector Education/ Research	Executed	adapt
	New Soil production in Sangone Park	Creation of an area of "urban forest" along the banks of the Sangone through the use of regenerated soil (New Soil), based on aggregates and compost from FORSU and innovative biostimulants.	Government Industry Education	Planed	regenerate
	Symbiosis between industry and SMEs	Businesses with material waste supporting local activities (third sector or community) or new entrepreneurial activity (CSR for the circular Economy) Food Waste /Construction waste/ Metals workshops	Government Industry Third Sector Research	Potential	adapt
	Patnership between recyling consortsium and local industry	Involve public services in material waste looping actions for the creation of local circular business opportunities.	Government Industry	Potential	
	Incentives bussines model based on recycling	Implement a circular business scheme in the area where local recycled resources are the base, another definition of reindustrialization of the area.	Government Industry	Potential	regenerate, adapt
	Industry incentives for recycle urban void	Businesses involved in the rehabilitation/ recycle of public abandoned land and infrastructure. (Incentives from the government for looping activities in the built environment)	Government Industry	Potential	adapt
Reuse	Platforms repair local products services	ICT Tools / APPs to network with the community on CE activities, to promote the repair services and reuse goods available.	Government Third Sector Education/ Research	Executed	regenerate, adapt, sharing, substitute
	Platforms on food waste	Platforms that promote sharing to prevent Food Waste with a local network of actors.	Government Third Sector Education/ Research	Executed	regenerate, sharing, substitute
	Incentives bussines model based on industrial repair	Enhance the industrial repair capacity of the precinct, an opportunity for the numerous Metals workshops.	Government Industry	Potential	adapt
	Awarness Events for share / repair	Third Sector organizations involved in empowering the strong sense of belonging present in the community through the promotion of reuse objects and repairing. Promoting their material culture and social cohesion. i.e. Tool Libraries, repair café's workshops and second-hand markets	Third Sector Education/ Research	Executed	adapt, sharing,
Energy Recovery	Incinerator energy production	The Incinerator executes Energy production from burned waste material	Government Industry	Executed	adapt
	Central Heating system	A Central Heating system for precinct households coming from incenartor heating power.	Government Industry	Potential	adapt , substitute

the precinct. However, as it also generates heat, the incinerator could serve as a central heating system for the precinct household. These strategies are aimed to have actively involved with community members, industry and government, in order to develop a participatory process to foster energy transition plans. This future implementation comes from a public funding perspective.

Overall implementation of loop strategies is starting to be integrated across the precinct, to reduces the amount of waste going to landfill and rendering an energy alternative to fossil fuels. These actions, at the same time, aimed to promote the sense of belonging at the same time a cleaner, safer and healthier precinct for those working and residing communities. This looping decreases the wastage of resources and avoids the environmental and economic expenses of landfill and pollution. Moreover, looping actions will also create jobs on energy production and recycling and reuse industries. Nevertheless, this will require significant effort from the government as opportunities for industrial symbiosis, remanufacturing of waste materials is under-developed in the Mirafiori South precinct.

LOCALIZE AND OPTIMIZE ACTIONS

As described in framework (Figure 4.5), the localise and optimised Circular Actions are at the base of implementation of the Circular City model. On that view, after describing the implementations of the main Circular Actions, it is relevant to do a brief research synthesis to overview where these actions are represented in the circular model for Mirafiori South precinct.

As localise action is one of the pillars of Systemic Design approach where the city flow resources must find local synergies in order to decrease energy utilised, emissions produced and resource decoupling—establishing local symbiotic capital required to promote sustainable good-practices needed for looping, adapting and regeneration actions. On a second layer, as described in framework (Figure 4.5), the optimised action is the capacity to optimise the consumption and production of resources through the adoption of efficient value chains. On that view in the Mirafiori South precinct, this action was an approach as follows:

- *Regeneration:* Fostering local greenery in the Mirafiori South precinct through cropping and biodiversity, enhancing the local consumption of goods and infrastructure. (see Table 5.19)

- *Adapt;* Fostering the use of the current urban voids, historical heritage sites and post-industrial infrastructure to be flexible and adaptable enough that meets today's cultural and economic interests keeping a strong sense of belonging—enhancing local culture within local communities and their infrastructure.(see Table 5.20)

- *Loop:* Fostering to reduces the amount of waste going to landfill promoting the flow of local resource through reuse, recycling, industrial symbiosis, remanufacturing of waste materials in the Mirafiori South precinct. Moreover, through the incinerator can render a local energy alternative to fossil fuels. (see Table 5.21)

Such implementations encourage the localisation and optimisation of local resources in living and industrial functions, which enhances local economy, environment and local communities, creating local value and making a resilient circular system.

SUPPORTING ACTIONS

As described in framework (Figure 4.5), the supporting actions share and substitute Circular Actions reinforce the implementation of the Main Circular. After describing the implementations of the main Circular Actions, it is relevant to do a synthesis of the role of supportive actions the Mirafiori South precinct.

As sharing action is the capacity to exchange resources in cities across a range of activities from local livelihoods to city infrastructure goods, in order to decouple resource consumption and waste production-practices needed for looping, adapting and regeneration actions. At the same time, the substitute actions replace resources, services and infrastructure for renewable choices or virtualization to decouple the consumption of resources in cities.

On that view in the Mirafiori South precinct, this action was an approach as follows:

- *Regenerate:* This action sharing actions mainly on the community garden implementation, where the exchange of cropping is promoted and are involved in food waste platform of the precinct. (see Table 5.19)

- *Adapt:* The sharing and substitute actions are involved in the reuse infrastructure or industrial voids, where businesses for sharing economy can be promoted (i.e. repair Caffe). Moreover, implementation Flexible Infrastructure and Community promotes platforms for sharing activities to enhance local culture supporting local, products and Pop-up events (workshops - festivals). (Communal apps, info about sharing, goods or community services) (see Table 5.20)

- *Loop:* The sharing and substitute actions are involved in the promotion of local repair platforms ICT Tools/APPs to network with the community on CE activities, to promote the repair services and reuse goods available. Also, another app on local food to prevent food waste with a local network of actors. More specifically, in substitute, the potential central heating system for the precinct that will make locally sourced the heat and energy of the precinct. (see Table 5.21)

CIRCULAR ACTIONS DYNAMICS

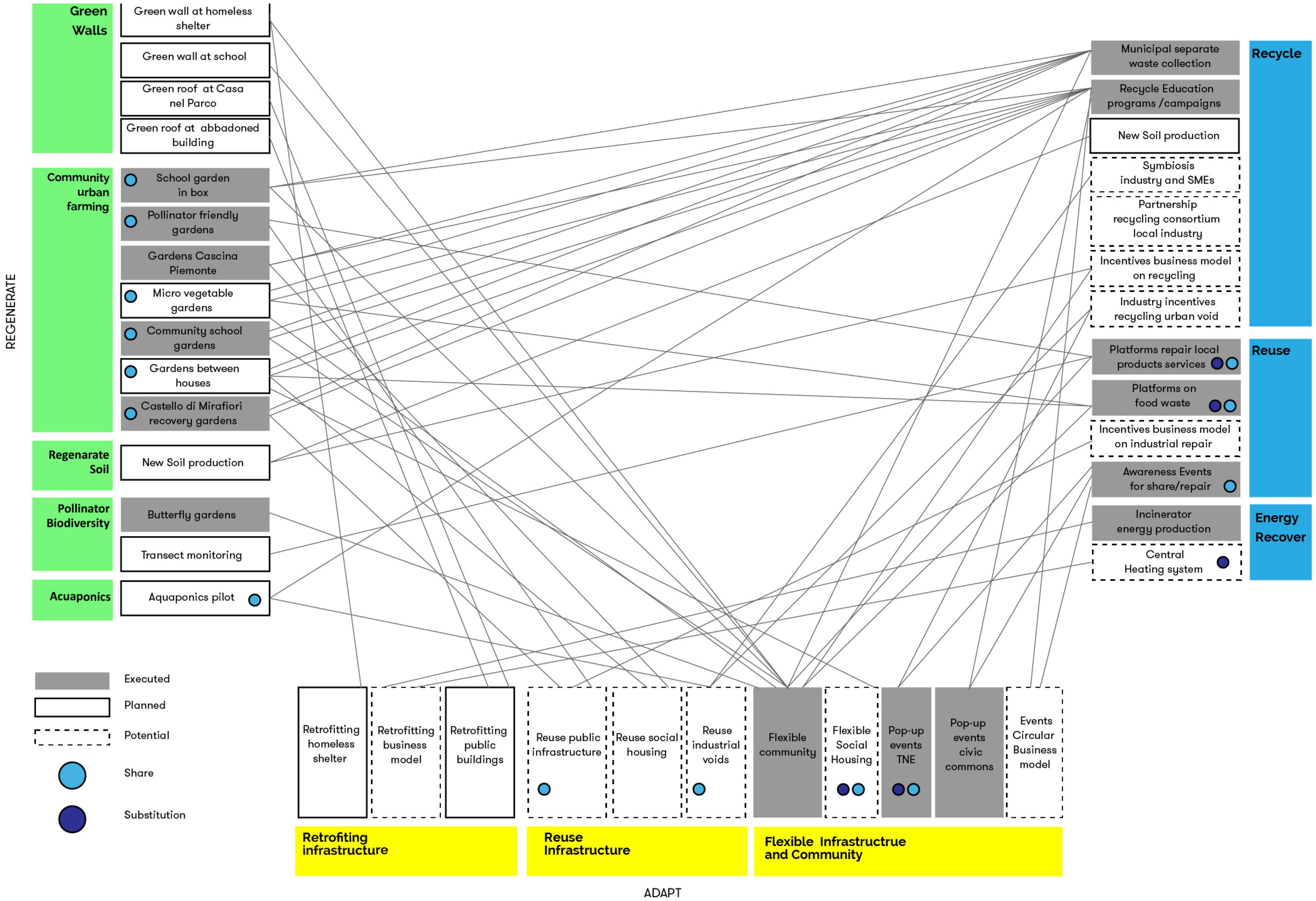
As described in section 4.7, the relation between the implementation of the Circular Action should generate a systemic dynamic (Figure 4.7), which will allow the understanding the gradual implementation of a Circular City model in the Mirafiori South precinct. After overviewing the Mirafiori Circular Action implementations (Table 5.19)(Table 5.20)(Table 5.21), the researcher prepared a synthesis of some of the synergies between Circular Actions (Figure 5.45). On the representation is reflected if the implementation is potential, planned or executed as this will influence the development between the dynamics.

On that view, the research found some exemplification on the relations of its synergies. For instance, the production of new soil for local forest/agriculture (loop) removes pollutants from Mirafiori polluted soil into a regenerated resource for local activities (regenerate). Also, community farming implementations for local cropping (regenerate) which are linked to the precinct platforms for food waste, looping all food resources in the precinct. In the case of the green walls implementations which aimed to bring vegetation and biodiversity in public buildings (regenerate), it also works as retrofitting action that can bring insulation to Mirafiori public infrastructure (adapt). Moreover, for community gardens, aquaponics or pollinator implementations (regenerate) are used as flexible infrastructure (pop-up activities) (adapt). Further, the reuse of post-industrial voids (adapt) should support the symbiosis of SMEs and industry new value chains (loop).

On the regeneration side, which is one of the most consolidated (most actions executed), the key lever is the community farming implementation it poised as the action with the most synergies. Regarding the adapt actions, which is an action with the most synergies, however, is not yet consolidated (most actions potential). Still, the implementation with most synergies is Flexible Infrastructure and Community, which could show that it could be potential leverage for change for the entire circular model. In the case of looping, even though most of it is implementations are potential, in each strategy has a consolidated implementation which serves as levers to activate other looping implementations, such levers are Municipal separate waste collection, Platforms on food waste/repair and Incinerator energy production.

Through comprehension the dynamics between the Mirafiori South precinct actions, it can distinguish the which actions are more likely to endure over time successfully. The purpose of this dynamic is a gradual transition that should create local value and deliver more realistic and feasible new economic, environmental and participatory activities.

Figure 5.45 Mirafiori South precinct Circular Actions Dynamics


REGENERATE
Green Walls
Green wall at homeless shelter
Green wall at school
Green roof at Casa nel Parco
Green roof at abbadoned building
Community urban farming
School garden in box
Pollinator friendly gardens
Gardens Cascina Piemonte
Micro vegetable gardens
Community school gardens
Gardens between houses
Castello di Mirafiori recovery gardens
Regenarate Soil
New Soil production
Pollinator Biodiversity
Butterfly gardens
Transect monitoring
Acuaponics
Aquaponics pilot
Executed
Planned
Potential
Share
Substitution
Retrofitting homeless shelter
Retrofitting business model
Retrofitting public buildings
Reuse public infrastructure
Reuse social housing
Reuse industrial voids
Flexible community
Flexible Social Housing
Pop-up events TNE
Pop-up events civic commons
Events Circular Business model
Retrofiting infrastructure
Reuse Infrastructure
Flexible Infrastructrue and Community
ADAPT
Municipal separate waste collection
Recycle Education programs /campaigns
New Soil production
Symbiosis industry and SMEs
Partnership recycling consortium local industry
Incentives business model on recycling
Industry incentives recycling urban void
Platforms repair local products services
Platforms on food waste
Incentives business model on industrial repair
Awareness Events for share/repair
Incinerator energy production
Central Heating system
Recycle
Reuse
Energy Recover
LOOP

5.9 Results analysis and feedback

Following the implementations and the circular system dynamics of the Mirafiori South precinct, this final step implied the assessment of the Circular Actions or new circular system (as explained in section 4.7.1). For that aim, the main Circular Actions were analysed in two parts through the lens of the Circular Economy Barriers (further explained in Chapter 2) and impact indicators (Table 4.5).

Taking in consideration the literature review on System Design approaching CE barriers was identified a range of barriers in implementing the proposed CE in Mirafiori South precinct (Table 5.22)(Table 5.23)(Table 5.24). Some of the challenges that hamper the process correlates to the necessity for systemic cultural change in from all key stakeholders involved community, industry, government and education (research), in order to restructure the current dynamics of the Mirafiori South precinct to support a Circular City model. Furthermore, other findings associated with the challenges in developing

REGENERATE		
STRATEGY		MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION
Green Walls	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure. Not reaching a Circular Bussiness Model, Economic viability, Need of financial incentive.
	Cultural	Not enough environmental awareness from local actors, Current lifestyles
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers
Regenarate Soil	Regulatory	Regulations on interventions on brown fields, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Not guarantee a Circular Bussiness Model, prospective resource value is uncertainty, Global supply chain, Cost of dealing with pollution, Restricted demand for looped sources, Health and safety risks, Low price of raw material
	Technological	Not enough market awarness about byproducts , Technical limitations, Absence of operational conditions, Modelling resource flows, Current linear resource flows
Community urban farming	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure, Not reaching a Circular Bussiness Model,Economic viability, Need of financial incentive.
	Cultural	Not enough environmental awareness from local actors, Current lifestyles
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers
Pollinator Biodiversity	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure. Not reaching a Circular Bussiness Model,Economic viability, Need of financial incentive.
	Cultural	Not enough environmental awareness from local actors, Current lifestyles
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers
Acuaponics	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure. Not reaching a Circular Bussiness Model,Economic viability, Need of financial incentive.
	Cultural	Not enough enviromental awarness from local actors.
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers
	Technological	Not enough market awarness about acquaponics, Technical limitations, Absence of operational conditions, Modelling resource flows, Current linear resource flows

Table 5.22 Main barriers to Circular Economy implementation Regenerate strategy Mirafiori South precinct

Table 5.23 Main barriers to Circular Economy implementation Adapt Mirafiori South precinct

ADAPT		
STRATEGY	**MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION**	
Retrofiting infrastructure	**Regulatory**	Regulations on interventions of public buildings or industrial , Urban Planning regulations on the energy grid, Absence of a supportive framework for retrofitting
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure. Not reaching a Circular Bussiness Model. Operational costs, Lack of financial incentive, Lack of public investment and reliance on private investment, Need of financial incentive, Financial risk, Absence of public expenditure and dependence on private expense.
	Cultural	Current value and norms, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions, Current linear resource flows
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers
Reuse Infrastructure	**Regulatory**	Urban Planning regulations on industrial land use, Absence of supportive framework, Regulations on interventions of public buildings, Regulations on interventions on polluted industrial sites
	Economic	Guarantee of continuous funding reuse buildings. Not reaching a Circular Bussiness Model, Operational costs, Lack of financial incentives, Lack of public investment and reliance on private investment, Absence of public expenditure and dependence on private expense
	Cultural	Not enough enviromental awarness from local actors,Not enough enviromental awarness from civil servants, Current value and norms, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers
Flexible Infrastructrue & Community	**Regulatory**	Urban Planning regulations on industrial land use, Regulations on interventions of civic commons Regulations on interventions on industrial polluted sites, Absence of supportive framework, Regulations on interventions of public buildings, Regulations on interventions on polluted industrial sites
	Economic	Guarantee of continuous funding, Operational costs, Lack of financial incentives, Lack of public investment and reliance on private investment, Absence of public expenditure and dependence on private expense
	Cultural	Not enough enviromental awarness from local actors,Not enough enviromental awarness from civil servants, Current value and norms, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers

Table 5.24 Main barriers to Circular Economy implementation Loop strategy Mirafiori South precinct

LOOP		
STRATEGY	**MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION**	
Recycle	**Regulatory**	Absence of a supportive framework for recycling, Lack of regulations on byproducts from polluted material, Emerging models for looped resources.
	Economic	Economic viability, Not reaching a Circular Bussiness Model, Limited demand for looped resources, Global Supply chain and global market effect of sustaining those activities/linear resource system, Cost of dealing with contamination or invest in the recycling process.
	Cultural	Not enough environmental awareness from local actors, Presence of the incinerator affects the waste separation on the precinct, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with the natural environment, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions, Current linear resource flows
	Institutional	Lack of availbility of land due to regulations, Recycling sites remain in the moyority out of the precinct, Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers

LOOP		
STRATEGY	MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION	
Reuse	Regulatory	Lack of incentives for repair facilities on civic commons, Absence of a supportive framework for reuse or repair, Emerging models for looped resources, Regulations on interventions of public buildings or civic commons.
	Economic	Economic viability, Not reaching a Circular Bussiness Model, Limited demand for looped resources, Global Supply chain and global market effect of sustaining those activities/linear resource system, Cost of dealing with contamination or invest in the repair/reuse process.
	Cultural	Not enough environmental awareness on repair and resue practices from local actors, Current social practices, Cultural diversity, Public unawareness of resource cycle, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions, Current linear resource flows
	Institutional	Lack of availbility of land due to regulations, Recycling sites remain in the mayority out of the precinct, Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers
Energy Recovery	Regulatory	Absence of a supportive framework for energy transition, Lack of regulations on energy production from polluted material, Emerging models for looped resources.
	Economic	Economic viability, Not reaching a Circular Bussiness Model, Limited demand for looped resources, Global Supply chain and global market effect of sustaining those activities/linear resource system
	Cultural	Not enough environmental awareness, Current social practices, Cultural diversity, Public unawareness of resource cycle, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions, Current linear resource flows
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymaker

the levers to activate such implementations from regulatory, economic, cultural, institutional, and technical.

Nevertheless, the barriers differ with resource and action type. For example, more regulatory challenges are faced by Adapt strategies (Table 5.23), than Regenerate strategies (Table 5.22), as there are more regulatory levers in one action (Table 5.7). Another example more technical challenge is faced by Loop strategies (Table 5.24), than Regenerate strategies (Table 5.22), as there are more cultural levers (local know-how) in one action (Table 5.6). Hence the information synthesised in the (Table 5.22) (Table 5.23)(Table 5.24) aims to deliver an overview of what challenges these implementations face. Still, there are five barriers which cut across resources and actions in the Mirafiori South precinct: scarce institutional support, absence of a supportive regulatory framework and current cultural values. These are the barriers if addressed, can serve as a lever to maximise the impact of the Circular Action and reduce the effects of the enlisted barriers.

So, to verify if the implementations have overcome such barriers (Table 5.25)(Table 5.26)(Table 5.27) are presented the expected impacts for each Circular Action, as the second part of the assessment. These findings aim to deliver an overview for all of the actors of the collateral effects each action could provide valuable data for monitoring the transition towards a Circular City model in Mirafiori South precinct.

The impact indicators presented in (Table 5.25)(Table 5.26)(Table 5.27) are across all stages in the implementation process (levers, actions and outcomes). The main aim that those indicators create awareness among the stakeholders of Mirafiori South precinct on the transition towards a Circular City model. In particular, for policymakers, it is crucial to distinguish what levers for developing Circular Action have been implemented effectively.

The range of impact indicators presented represent are from qualitative to quantitative data are intended to have a holistic perspective of the process and provide a useful political instrument for monitoring and allocating funds towards achieving a Circular City model for Mirafiori South precinct.

Nevertheless, as the data of Mirafiori South impact indicators are reported from different stakeholders Industry, Third Sector, Government and Education

Table 5.25 Implementation impacts Regenerate strategy Mirafiori South precinct

REGENERATE		
STRATEGY	**IMPLEMENTATION IMPACTS**	
Green Walls	**Urban Fabric**	Reduce CO2 emissions, Reduce air pollutants, Increase of leisure/recreational spaces in Green Space, Increase of biodiversity, Reduction of a heat island effect, Increase energy efficiency retrofitting effect.
	Demography	Decrease of chronics diseases, Improve mental health, Increase of social cohesion, Improve learning performance.
	Economic	Increase skills diversification, Increase job creation
	Cultural	Increase of environmental awarness, Increased community participation, Increase the local know-how, Increase of Green Public procurement.
Regenarate Soil	**Urban Fabric**	Increase land use for agriculture, Reduce brown field areas, Increase of leisure/recreational spaces in Green Space.
	Economic	Increase circular SMEs, Increase skills diversification, Increase high quantity of recycled soil, Increase awarness on CE investment programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness, Increase of Green Public procurement
Community urban farming	**Urban Fabric**	Increase land use for agriculture, Increase of leisure recreational spaces in Green Space, Increase of biodiversity, Reduction of a heat island effect
	Demography	Improve food security value chain, Improve of mental health indicators, Increase of social cohesion, Improve learning performance, Improve of indicators on healthy diets.
	Economic	Increase local production, Increase circular SMEs, Increase skills diversification, Increase job creation.
	Cultural	Increase of environmental awarness, Increase promotion of heritage of local products/recepies, Increase community participation.
Pollinator Biodiversity	**Urban Fabric**	Reduce CO2 emissions, Reduce air pollutants, Increase of leisure/recreational spaces in Green Space, Increase of biodiversity, Reduction of a heat island effect.
	Demography	Decrease of chronics diseases, Improve of mental health Indicators, Increase of social cohesion, Improve learning performance.
	Economic	Increase skills diversification, Increase job creation
	Cultural	Increase of environmental awarness, increase community participation
Acuaponics	**Urban Fabric**	Increase of leisure/recreational spaces in Green Space, Increase local production
	Demography	Improve food security value chain, Improve of mental health indicators, Increase of social cohesion, Improve learning performance, Improve of indicators of healthy diets
	Economic	Increase local production, Increase circular SMEs, Increase skills diversification, Increase job creation.
	Cultural	Increase of environmental awarness, Increase the promotion of heritage of local products, Increase community participation.

Table 5.26 Implementation impacts Adapt Mirafiori South precinct

ADAPT		
STRATEGY	**IMPLEMENTATION IMPACTS**	
Retrofitting infrastructure	**Urban Fabric**	Increase of energy optimization in neighborhood infrastrucre, Reduce CO2 emissions, Reduce air pollutants, Increase of biodiversity, Reduction of a heat island effect
	Demography	Improve of health standars, Increase of social cohesion indicators
	Economic	Increase optimize energetic consumtion expinditure, Increase savings of public expenditure, Increase circular SMEs, Skills diversification, Increase awarness on CE investment programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness on local resources, Increase of Green Public procurement.
Reuse Infrastructure	**Urban Fabric**	Increase of spaces for businesses and local activities, Increase regenerated areas
	Demography	Increase of social cohesion, Improve learning performance, Improve of mental health indicators.
	Economic	Increase local production, Increase circular SMEs, Increased skills diversification, Increase awarness on CE investment programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness, Increase of Green Public procurement, Increase promotion heritage
Flexible Infrastructrue & Community	**Urban Fabric**	Increase of leisure/recreational spaces in Green Space, Increase of spaces for businesses and local activities, Increase regenerated areas
	Demography	Increase of social cohesion indicators, Improve learning performance.
	Economic	Increase local production, Increase circular SMEs, Increase skills diversification, Increase awarness on CE investment programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness, Increase promotion heritage of local products, Increase of Green Public procurement.

LOOP		
STRATEGY		**IMPLEMENTATION IMPACTS**
Recycle	Urban Fabric	Increase of spaces for businesses and local activities, increase regenerated areas.
	Demography	Increase of social cohesion, Improve learning performance, Increase number of local skills,
	Economic	Reduction of waste going to landfill, Increase high quantity of recycled material, Increase awarness on CE investment programs, Increase number of local jobs, Increase local production, Increase circular SMEs
	Cultural	Environmental awarness, Increase the local know-how Increase awraness of local culture, Awarness on local resources, Increase of Green Public procurement.
Reuse	Urban Fabric	Increase of spaces for businesses and local activities, Increase regenerated areas,
	Demography	Increase of social cohesion, Improve learning performance, Increase number of local skills,
	Economic	Reduction of waste going to landfill, Increase high quantity of recycled material, Increase awarness on CE investment programs, Increase number of local jobs, Increase local production, Increase circular SMEs
	Cultural	Increase of environmental awarness, Increase the local know-how,Increase of Green Public procurement.
Energy Recovery	Urban Fabric	Increase of energy optimization in neighborhood infrastrucre, Reduce CO2 emissions.
	Demography	Improve of health indicators
	Economic	Increase optimization of local energy systems, Increase savings of public expenditure, Increase circular SMEs, Increase skills diversification, Increase awarness on CE investment programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness, Increase of Green Public procurement.

Table 5.27 Implementation impacts Loop strategy Mirafiori South precinct

/Research institutions, the monitoring can be challenging. As a result, the impact indicator data is produced currently in “silos”, which is one of the main barriers that Circular City models face, and this research project aims to overcome. For example, the economic indicators on looping actions (industry related) are measured by the Chamber of Commerce of Turin and the information is not available to the public nor the relevant stakeholder in the precinct. These current situations have hampered to proposed systemic solutions as there is not enough horizontal dialogue among the relevant stakeholders. Still, this will be essential for monitoring the progress of the process, to develop support and to distinguish the difficulties that may arise from it.

Furthermore, the findings on the implementation barriers and impact indicators are crucial for the success of the Mirafiori South precinct Circular Actions Dynamics (Figure 5.45) as they present a useful governmental mechanism to monitoring these dynamics and allocating funds to Circular City models. At the same time, this feedback analysis highlighted potential difficulties caused by adopting these actions or collateral effects.

5.10 Discussion Governance for a Circular City model for Mirafiori System Dynamic

This section aims to discuss the results of the Systemic Design Framework for Circular Cities (Figure 4.4) undertaken to the Mirafiori South precinct case study. As presented in the previous sections, the framework established ways in which Systemic Design diagnosed and assessed a more inclusive and cohesive policy design for a Circular City model for Mirafiori South precinct. The dynamics of the theoretical conceptualization were reflected on (Figure 5.45), which reflects the complexity of the precinct Circular Actions relationships. These findings prove positive synergies are linking all three Circular Actions which support each other, to maximize the benefits. Nevertheless, this research investigation also acknowledges that further data is required to examine these dynamic interactions thoroughly.

SYSTEMIC IMPLEMENTATION & FORESIGHT

In order to discuss the complexity of the outcomes, the researcher synthesised Mirafiori South Circular City model in (Figure 5.46). Additionally, to understand the systemic implementation that such model will imply, on (Figure 5.47) is highlighted the status for each implementation (executed, planned, potential) based on information of tables (Table 5.19)(Table 5.20)(Table 5.21).

The (Figure 5.46) provides a panorama from the synergies between Circular Action. Also, it indicates the combination of actions which may work together successfully on the Mirafiori South precinct. In particular, (Figure 5.46) presents Adapt and Regenerate as the actions with the most connections with other actions on the in the system.

However, in (Figure 5.47), it evidences that most of Adapt implementations are potential and that very little has been executed, but also it reflects that Regenerate implementations are the most consolidated (Executed). This is due to the strong presence of natural capital as the precinct is a peri-urban area and the considerable number of programs and policies supporting Regeneration actions in the precinct (Table 5.3). Therefore, this action is the crucial lever to activate the new circular system for Mirafiori South precinct, as it will influence the other Circular Actions directly activating the transition of the system. In particular, these outcomes should serve all stakeholders, but particularly City officials and policymakers to approach Regeneration actions as the key to Circular City model but also target funds and programs for Adapt and Loop actions that are considerably not executed in the precinct.

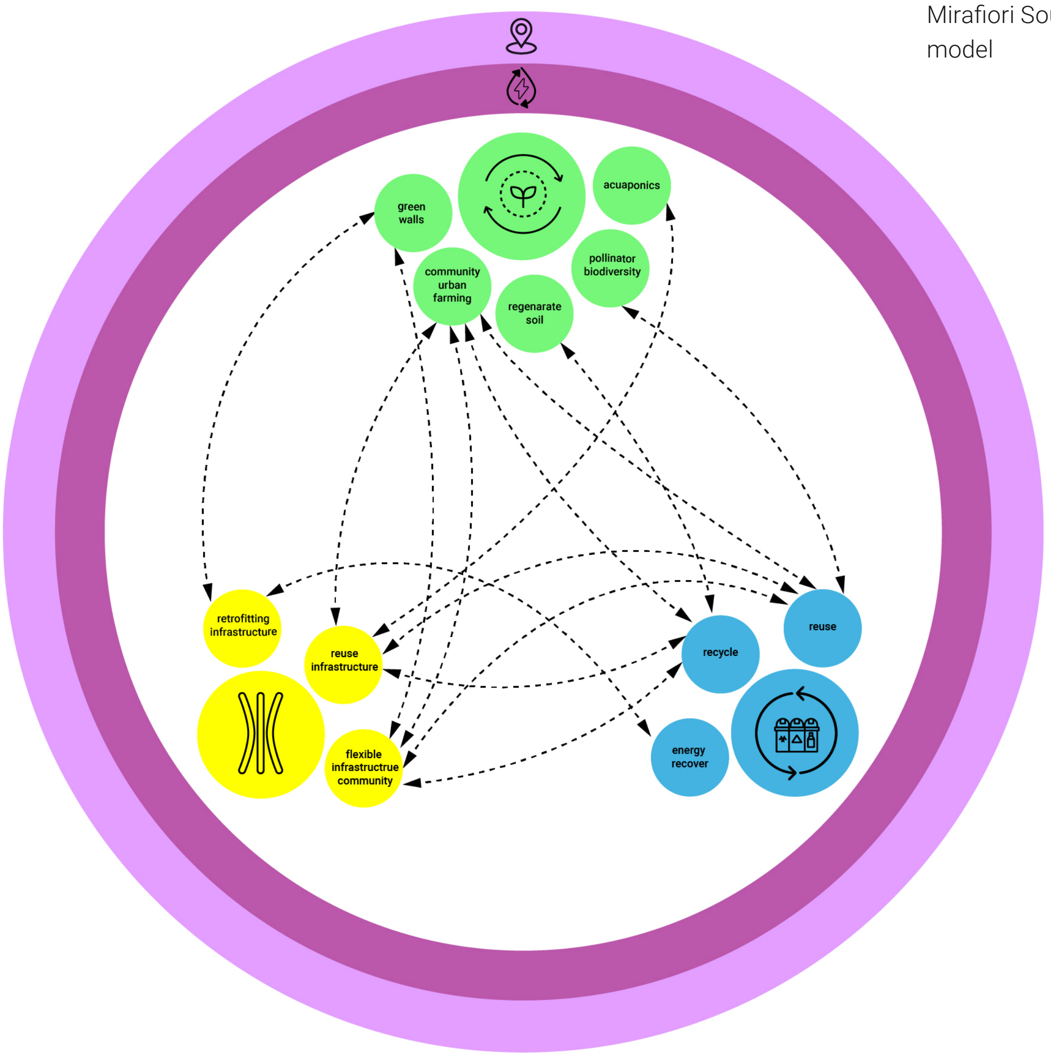


Figure 5.46 Synthesis Mirafiori South Circular City model

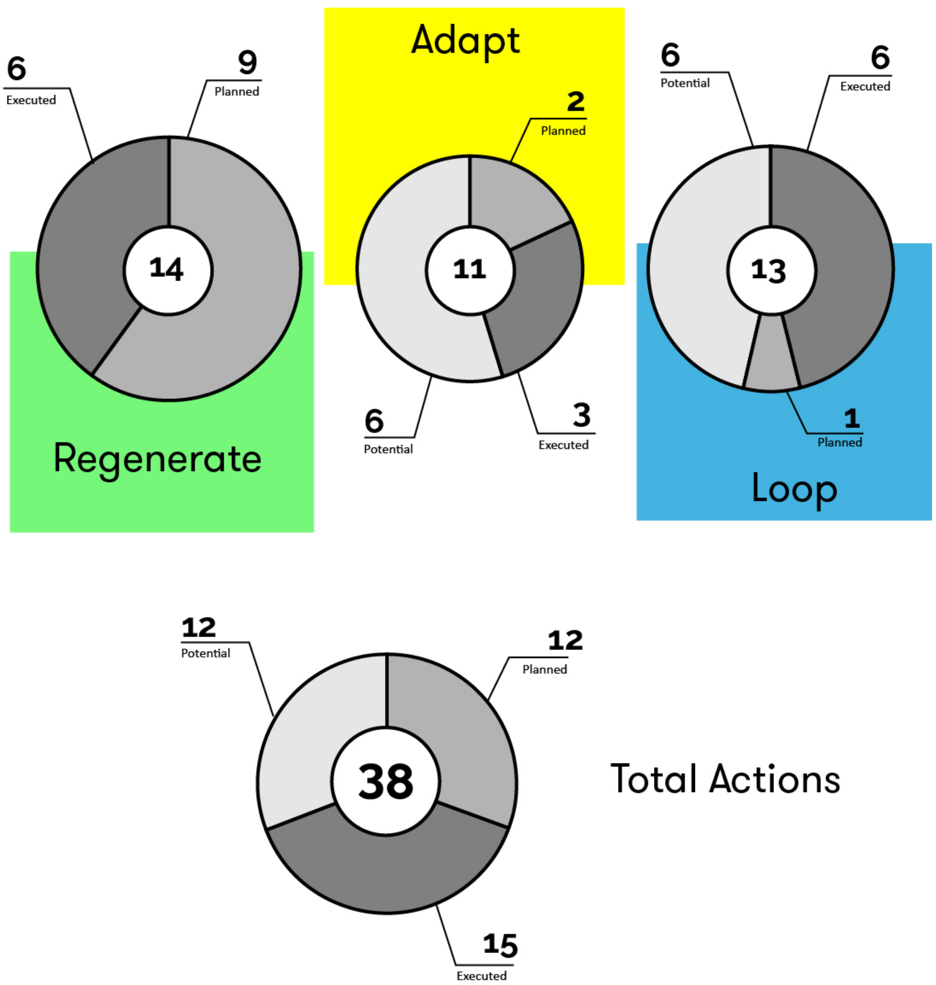


Figure 5.47 Implementation status for Circular Actions Mirafiori South

This Circular City model for the Mirafiori South precinct presents and strategy to transition to a new model system that creates/enhances local value within the territorial assets present on the Holistic Diagnosis. Precisely, because of the System Design approach applied, it was possible to identify and to define actions tailored to the needs and tools available in the Mirafiori South precinct.

This framework results implied that for an implementation process of a Mirafiori South precinct Circular City model should entail a systemic approach to stakeholder engagement and activity development, that intends a policy change over time. On that perspective, it is permissible to conceive the implementation impacts of the different Circular Actions have different timing for their execution. In this process was exposed the "actionable and proactive" mindset (see Chapter 2) of the Systemic Design that combined with a foresight vision, could propose concrete outcomes in the short term (i.e. third sector regeneration actions like community farming) while addressing broader actions in the long term (i.e. potential industrial symbiosis between manufacture industry). From that point of view, Systemic Design suggested a gradual introduction CE policies/strategy for Mirafiori South precinct developing within a short (executed), medium (planed) and long term (potential), where the short and medium ones are designed to support future implementations. To illustrate how Mirafiori South precinct Circular City model systemic implementation is framed on a long-term horizon effect on CE policy planning process, it is worth to narrow an insight to the analysed implementation impacts indicators (Table 5.27)(Table 5.28)(Table 5.29).

VALUE CREATION ON MIRAFIORI SOUTH PRECINCT

According to the presented results, through the Systemic Design approach was possible to comprehend the nature of the wicked problems of Mirafiori South precinct, which are hampering its way into circularity. This research project analysis revealed that the interconnected nature of such critical drivers has a significant impact on how public policy has been implemented over the years, mainly promoting traditional urban regeneration and reindustrialisation programmes and policies, which do not promote local value.

Moreover, this result proved that the wickedness Mirafiori South precinct is reinforced by a linear model of governance, which has enclosed the precinct challenges into "silos" and limited the understanding of the bigger picture by managing authorities, community, industry and education (research). This bureaucratic model was particularly challenging during the data collection process, as different local government institutions managed different data sources. On that view, it was possible to comprehend the reason why the past regeneration process in the precinct has never been appropriately articulated as has been approached in a traditional linear and analytical method of problem-solving. These current dynamics can hamper any transition to circularity in Mirafiori South precinct in the present and the future, as there has been a poorly holistic involvement of a quadruple helix stakeholder dynamic.

With this in mind, in order to achieve a transition of CE is necessary to disrupt governance silos in Mirafiori South precinct, to do so this research investigation proposed a shift on the current policymaking/decision methods, through the implementation Systemic Design approach. The results of this systemic assessment for Mirafiori South case study undertaken with Systemic Design Framework for Circular Cities (Figure 4.4) proposed a more adaptive and collaborative policymaking process , which comprehended all territorial assets from opportunities to challenges for local value creation and all current levers policies & projects that could support future CE strategies.

Such territorial assets visualised in section 5.4 brought into evidence many "sleeping assets", that were not considered before by any other regeneration or circular strategies currently present in Mirafiori South precinct. For example, the mapping revealed a considerable amount of metalworking workshops that could unlock more reuse/ repair strategies. Such a holistic view exposed hidden assets that can create local value if enhanced, can be the key for circularity in Mirafiori South.

Parallel to this, the analysis of the Mirafiori South Policy Framework (see section 5.3.1.2) reveal what policies or grassroots programs have support directly or indirectly circularity, the most relevant ones addressing CE directly in the precinct Torino City Lab and Mirafiori Cultura in Circolo. However, it also underlined the lack of policy instruments to activate a circular process in the precinct and that most circular programs are coming from a bottom-up perspective, proving that circularity is coming modestly from a local value perspective.

In addition to this, the research process of the Mirafiori South Stakeholder Identification (see section 5.3.1.3) presented the mapping of the main stakeholders to articulate a quadruple helix that resiliently creates value over time. Still, the analysis went beyond the "lead stakeholders" (FIAT, Fondazione Mirafiori, Politecnico di Torino and City of Turin) revealing a broader spectrum of precinct actors from SMEs to community organizations that are enrooted in the precinct and can provide a circular dynamics that can guarantee local value creation over time. Such "unnoticed" actors can have a game-changer role in the path towards a holistic and resilient vision of a Circular City model for Mirafiori South precinct.

Those drivers led the research process into the exploration of Circular City public policy leverages that were translated into CE actions underlined in (Figure 5.46) Synthesis Mirafiori South Circular City model and (Figure 5.47) Implementation status for Circular Actions. These results proposed a new Circular City model system for Mirafiori South that through anticipatory scenarios, could bring more future-oriented and sustainable-oriented policy actions to enhance local value creation.

Although, the research results recognise that such system transitions in Mirafiori South towards circularity will disrupt the established investments, jobs, behaviours, knowledge and values as automotive precinct par excellence. At the same time, the proposed framework of this research presented evidence on policy design that instruments to enhance local value such as natural capital or local know-how which are more likely to be consistent and cohesive with long-term environmental goals within the Mirafiori South precinct. Furthermore, through the precinct system visualisation (see section 5.4) and (Figure 5.46) Mirafiori South Circular City model, initiated a horizontal conversation within a quadruple helix dynamic strengthening and creating synergies. To provide a common understanding of complex problems and sharing responsibilities to cope with a change towards circularity.

A SYSTEMIC DESIGNER ROLE

On the results of this Case study research, the Systemic Design has shown the means and knowledge to navigate this wicked scenario aiming to maximise the value of government, in this case, the decision-making process of City of Turin civil servants. On that view, enriching Bason's (2018) exploration of the designer's roles in the policy design process, the framework here developed recommended the designer/researcher to act as a mediator between the bottom-up Mirafiori South community (and third sector) and top-down City of Turin/Turin Chamber of Commerce (Industry). The designer interacted within a skillset to anticipate future situations and generate innovative outcomes promoting new approaches to complexity. In particular, the supportive role of the designer as an 'agent of change' (Green, 2013) was underlined, which here entailed advocating on activating Mirafiori South local assets, among all local stakeholders directly involved, spreading complexity over the various nodes in the system instead of seeking a single, large, complex and unitary top-down solution.

The roundtable discussion provided a neutral space for stakeholders to initiate synergies for the envisioned Circular City model. Therefore, promoting a decision-making mechanism that encourages local assets and social innovations to co-creating circular strategies, be sustained and scaled up through the synergy and support of the top-down institutions, in this case, Turin municipality.

Overall, the Systemic Design Framework for Circular Cities (Figure 4.4) here developed contributed a holistic comprehension of the Mirafiori South precinct towards co-designing situated circular strategies for decision-making. The study also examined through the systemic design tools for CE policy design that can address the wickedness of Mirafiori South precinct and highlighted the need to support active cooperation among local actors.

In conclusion, throughout this Mirafiori South Case Study, the value of the systemic designer lied in interweaving a systemic transition for that, it experimented with design instruments that show the involved stakeholders the possibilities to transition towards a Circular City model carrying the legacy of the automotive precinct and unveiling ways to build local value.

5.11 Reflections and following work

This examination contributed to filling a gap in the knowledge of a situated and embedded approach to systemic design for CE policy design, which – for this research – was developed concerning post-industrial precincts. This Mirafiori South precinct Case Study allowed bridging from the theoretical proposition of Systemic Design Framework for Circular Cities (envisioned in the Scoping Study) to the practices co-designing situated circular strategies for decision-making. The following paragraphs summarise the key conclusions of this study, concerning both the Circular City model for Mirafiori South precinct and the Systemic Design process.

5.11.1 Key Conclusions Mirafiori South precinct

- The Systemic Design Framework for Circular Cities (Figure 4.4) undertaken allowed a profound holistic comprehension of the Mirafiori South precinct, providing an appropriate diagnosis of all area as a complex web of assets from the surrounding natural capital to the predominant legacy of the automotive city-factory precinct which proved to have the potential to create value and foster the transition towards a Circular City model. Such an overview was possible through the results of the desk research and field research, which highlighted the Mirafiori South wicked problems complexity which comes from mainly from its deindustrialisation process promoted by years of a linear economic and governance model. The proposed Systemic Design approached allowed to designing a Circular City model that overcame the Mirafiori South wicked barriers to the CE.

- To overcome the critical issues of Mirafiori South deindustrialisation such as depopulation and poverty increment. The proposed Circular City model for the Mirafiori South precinct presented on the Holistic Diagnosis a strategy to transition to a new model system that creates/enhances local value within the territorial assets. Also, it promotes more and resilient local livelihoods that do not depend entirely on external factors like the global economy or a single dominant industry (automotive) and that are resilient over time. As a result, such a model for value creation will enhance the life quality attracting new population and more opportunities for the current and upcoming population.

- The Holistic Diagnosis performed a central role in scoping the precinct context, collecting qualitative and quantitative data and visualising the precinct, from a broader lens within the collection of various feedbacks from all stakeholders groups; civil servants (city of Turin), industry (Turin Chamber of Commerce, and community (Third sector organisations - Mirafiori Foundation) and education (Research institution and local schools). This research examination revealed that the interconnected nature of Mirafiori South wicked problems which are embedded in the dominant automotive mass production culture that conceived the precinct. Such wickedness has been reinforced over time by a linear model of governance and economy, which has enclosed the precinct socio-economic challenges into "silos", narrowing the understanding of the bigger picture by managing authorities, community, industry and research institutions, where reindustrialisation and regeneration plans seem the only answer. Therefore, the Holistic Diagnosis process acknowledged the strong presence of the cultural barrier rooted in the current cultural paradigm base on the traditional structures with linear thinking for economical, social and environmental development. At the same time has turned the precinct more and more isolated from the city as a deprived deindustrialised ghetto generating more wickedness. To address a better understanding of such challenges, the Holistic Diagnosis enabled the visualisation of opportunities and challenges for value creation, making possible to identify and to define actions tailored to the needs and tools available in the Mirafiori South precinct.

- The outlined strategy of the study was the Mirafiori South Circular City model in (Figure 5.46). The systemic implementation that such model will suggest the Regenerate Circular Action as the crucial lever to activate the new circular system for Mirafiori South precinct, as it will influence the other Circular Actions directly initiating the transition of the system. In particular, these outcomes should serve the proposed quadruple helix networks of stakeholders who could support the implementation of the Mirafiori South Circular City model to reach horizontal dialogue and collaboration between bottom-up initiatives and top-down. Moreover, the approach of Regeneration actions in particular for this precinct represents a key lever towards a Circular City model but also target funds and programs to Adapt and Loop actions that are considerably not executed in the precinct.

- The study highlighted the main CE barriers that the proposed Mirafiori South Circular City model which cut across resources and actions in the precinct: scarce institutional support, absence of a supportive regulatory framework and current cultural values. The identification of such barriers can serve as a lever to maximise the impact of the Circular City model and reduce the effects of the enlisted obstacles.

- This framework results implied that for an implementation process of a Mirafiori South precinct Circular City model should entail a systemic approach to stakeholder engagement and activity development, that intends a policy change over time. The Systemic Design Framework for Circular Cities intended to inform a policy design process within Mirafiori South precinct on the lens of the Circular City model. At policy-making level, these results will aim to change local policies on Mirafiori South precinct, fostering better governance and disseminate innovative solutions towards a CE at multiple levels such as:

  a. *On the technical level*, through the Circular Actions implementations presented, based on the local energy and material flow (urban metabolism networks) through which will result in the creation or redesign of local, circular supply chains. In the case of Regenerate actions, technicalities are present in the precinct thanks to the partnership of the community and research institutions. Also, Loop activities at the community level are attracting all the educational tools and dissemination of the technical aspects. However, at the industrial level, it will require more technical support with Adapt and Looping (industrial) actions, in order to enhance the local skills on the technical side to implement the circular strategies and create local value.

  b. *On the social level,* support the strong network of Third sector organisation enabling more citizen-based ownership of local resources on post-industrial voids/infrastructures through co-designing, co-creating, and co-implementing of new protocols for the integration of CE strategies. Thanks to the third sector organisations, Mirafiori South has a significant amount of implemented bottom-up circular strategies, which have shaped the Circular City model outcome.

  c. *On the economic level,* through systemic approaches boosting circular business models for products and services on all Circular Actions, highlighting market opportunities and public-private partnership models for circular productive activities. The suggested implementations Mirafiori South precinct Circular City model intend to propose a new economic model for the precinct-based on local assets and know-how, in order to generate a more resilient local economy. To overcome the systemic effects of de-industrialization and reactivate economic growth, fostering a transition into a productive and stimulating place to live and work in that would restore residents' sense of belonging and attract investment.

  d. *At a cultural level,* the proposed circular strategies in order to be resilient must meet today's cultural and economic interests of Mirafiori South keeping a strong sense of belonging generated from its working-class origins. The strong identity of the precinct has grown in the last years as the third sector has invested enormous efforts to promote a historical archive of the precinct and the cultural heritage from the automotive era. At levels of CE this awareness has been growing over the years at the community level, from that point of view, the Circular Action strategies must foster Mirafiori precinct into a post-industrial heritage site, such as UNESCO conservation sites. Enhancing a local identity and a strong sense of belonging to the precinct and value creation.

  e. The systemic implementation process of the Mirafiori South precinct Circular City model suggested gradual introduction CE policies/strategy for the precinct developed within a short, medium and long term. The study presented that the Regeneration and Loop actions been the most executed are likely to display short-term results which can support middle term (planned) and future (potential) implementations. To do so, the examination delivered a decision making an instrument that can address the wickedness of Mirafiori South precinct within a long-term resilient perspective. On an immediate effect, the presented framework can actively support cooperation among local actors on the ongoing plans to turn Mirafiori South on the first circular precinct of Turin.

- On a value creation point of view, the localise Circular Action proved to be one of the pillars of Mirafiori South according to the systemic principles, as it embraced all Circular Actions targeting precinct synergies and establishing a potential local symbiotic capital. In the case of Mirafiori South precinct, this meant creating new partnerships between the industrial heritage, the natural capital, the socio-technical system (working-class precinct), local industries and the city government, ensuring a resilient value creation dynamic.

5.11.2 Key Conclusions on Systemic Design

- The researcher tested the Systemic Design Framework for Circular Cities developed from the in the scoping study (Chapter 4) on the post-industrial precinct of Mirafiori South. In this view, the framework constructed a top-down/ bottom-up approach including a quadruple helix dynamic with all stakeholders groups; civil servants (city of Turin), industry (Turin Chamber of Commerce), community (Third sector organisations - Mirafiori Foundation) and education (Research institution and local schools). It delivered a policy co-designing process that led to the Mirafiori South Circular City model which intended to increase awareness on CE local resources, opportunities, and challenges and resilience of the precinct.

- The study highlighted the need for systemic thinking when approaching a CE not only from a governance perspective but an awareness that involves all the stakeholders. Also, it proved that a Circular City model panorama requires a foresight horizons perspective to enable long-term decision-making. The results presented and adaptive governance Circular City model that shows how systemic design approach can deliver resilience for CE governance.

- The approach here developed territorial thinking immersion on Mirafiori South precinct through the Holistic Diagnosis tool. Such an instrument delivered a comprehensive system complexity perspective of the precinct, going deep into the assets that have been unnoticed for the dominant vision of an automotive precinct. Such a process was enriched by the research synthesis and visualisation paving an efficient way to interpret current and new circular strategies in Mirafiori South.

- On the examination, the stakeholder engagement within a quadruple helix approach had success because through the process; the stakeholders were stimulated to think holistically and to overcome divisions between different sectors and roles, pursuing shared objectives for the precinct. For instance, the industry partners were able to notice the synergies on circular opportunities with community associations in Mirafiori South.

- The study highlighted how the systemic designer's mindset and methodology could be supportive strategic CE decision-making, developed in a collaborative and multi-stakeholder process. Also favours the visualisation of opportunities for value creation, enhancing the active collaboration between stakeholders, and boosting locally based value chains, delivering innovative strategies on the micro/macro scale and the short/long term.

- This research presented the required strong synergies among all the Mirafiori South stakeholders to implement a Circular City model successfully. On that view, this study emphasised that collaborative policy design processes, developed among different stakeholders, are essential to moving towards value creation in a long-term horizon: they enhance social learning and capacity building, they build trust, and mediate the power through cross-sector collaboration.

- The applied framework on Mirafiori South precinct implied Systemic perspectives and participatory methodologies that trigger innovative processes of sharing knowledge and experiences among different stakeholder and can build innovation in the public sector. Applying a systemic perspective into those strategies means to favour adaptive governance, whose outcomes are iterative and autopoietic, creating endurable public value.

- Ultimately, the roundtable discussion on the system design phase served as a way to initiate an active decision-making process within the local stakeholders to take responsibility on co-creating a Circular City model for the Mirafiori precinct. In this view, instead of presenting fixed systemic design outcomes, an on-going process of transformation was activated.

Finally, the Circular City model for Mirafiori South exemplifies disruptive and transformative dynamics, as a practical methodology to enhance the CE transition. The Systemic Design Framework supported these results for Circular Cities in Post-industrial precincts, which brought a systemic policy approach for an effective CE policy-making, incorporating different policy interventions to boost the cooperation in Quadruple Helix—in this way, creating a doorway where designers, managing authorities, and citizenship can effectively co-develop new policy opportunities.

5.11.3 Limitations of the Study

The researcher had previously executed research work for the City of Turin Department of Innovation and Smart City, on that view, they accept to collaborate for this examination as they were interested in integrating some of the outcomes. They provided access to some of the city database. However, the required data was not centralized, and it was necessary with the support of the Department of Innovation and Smart City to send a request of different databases to different city agencies. In that phase, the researcher faced the problem of different city agencies in “silos”, as some of them wanted to cooperate with others not. Also, this is reflected in the data update this affected the research outcomes. In the end, it was possible to gather most of the data, thanks to the direct relationship with the city officials otherwise was impossible to carry such research. This limitation proved that so many of the decisions are “behind closed doors” if city agencies are unable to share among them vital data.

The researcher requested the support of the Turin Chamber of Commerce for most of the economic data, as they have a database on the census of all city industry. Moreover, they have a material flow database were each industry with registers the material inputs and industrial waste. However, they only provide the typologies, not the total amount of industrial waste; this impacted the results. Still, they found interesting the aim of the research to potential local symbiosis among Mirafiori South industries and with the local community. In general, there is a low interaction between the Mirafiori industrial and the local community.

In particular, the roundtable co-design process suggested the repercussions and limits of the collaborative processes that faced a Systemic Design approach in such a context. In the context of Mirafiori precinct, organizing such meetings can be challenging as each stakeholder have their own agenda for their precinct. On the encounters, it was visible that they are not used to work in a quadruple helix dynamic, but each stakeholder has an individual relationship with the managing authorities. Even though the City of Turin is municipality involved continuously in many co-design for Mirafiori precinct, this was particularly more challenging as it meant to involve a quadruple helix that was not articulated before processes, in particular the axis between the industry and the community.

Another limitation was the strong desire from some stakeholders which only see “reindustrialization” as the only way to reactivate the precinct. Because of these strong beliefs, the Systemic Design participatory approach in some circumstances of the examination faced scepticism from some stakeholders. Nevertheless, some along the way start to embrace and understand the holistic approach, is an on going process.

For this examination, the collaboration with the third sector representative Fondazione Mirafiori was vital to understand the broad spectrum of the Mirafiori South community. They share databases of their executed projects in the community. Also, they provided their reports on the estate of the art of the precinct. The researcher attended many of their community events in several field visits. However, on the framework development, it was visible that the bottom-up outcomes are not present enough in the decision making of the City.

5.11.4 Next Steps

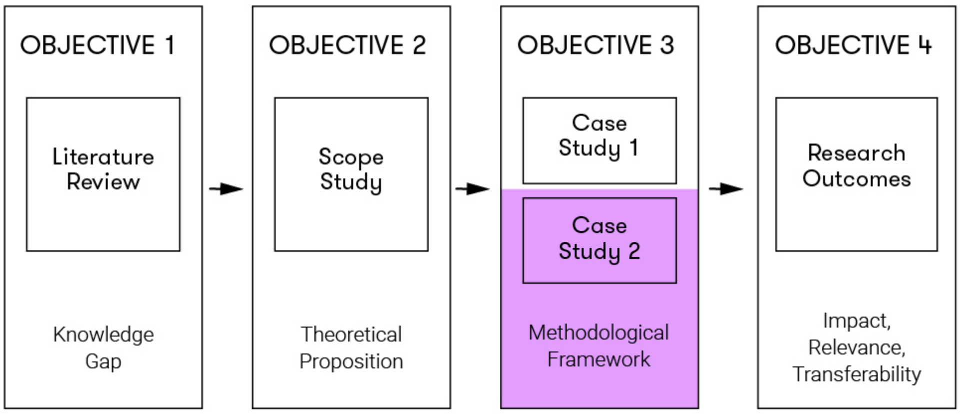
The contribution of this study lies within the activation of the Mirafiori South to transition towards a Circular City model. Still, much more investigation needs to be done to examine further dynamics between actions and experiment those already identified. Also, given that the policy implementation for to foster the process towards a Circular City model implies time, resources and contextual factors, which go beyond the scope of this doctoral research, assessing the impact of the proposed model is left open for future work.

On the theoretical contribution of this research to the systemic design field, the applied framework developed in a European city (Global North) will be reviewed and asses with outcomes of Chapter 6 on an African city (Global South). On that view Chapter 7, will assess how this investigation aimed at assessing the impact, relevance and transferability of the proposed circular framework in other cities, as well as at highlighting the limitations of the research and presenting recommendations for future work.

Lastly, the City of Turin Department of Innovation and Smart City wants to keep the discussion forward on the results of this research. In order to integrate some, the aspects to the current vision for Mirafiori South as the first circular precinct of Turin.

Chapter 6

Atlantis Precinct Case study



This chapter introduces the Atlantis precinct Case Study, addressing research objective 3, "developing Systemic Design approaches for Circular City frameworks to co-designing situated circular strategies for decision-making·" on a global south context. The following Case Study was undertaken, informed by the Systemic Design Framework for Circular Cities in Post-industrial precincts (Figure 4.4) developed to evaluate it in a real-world context.

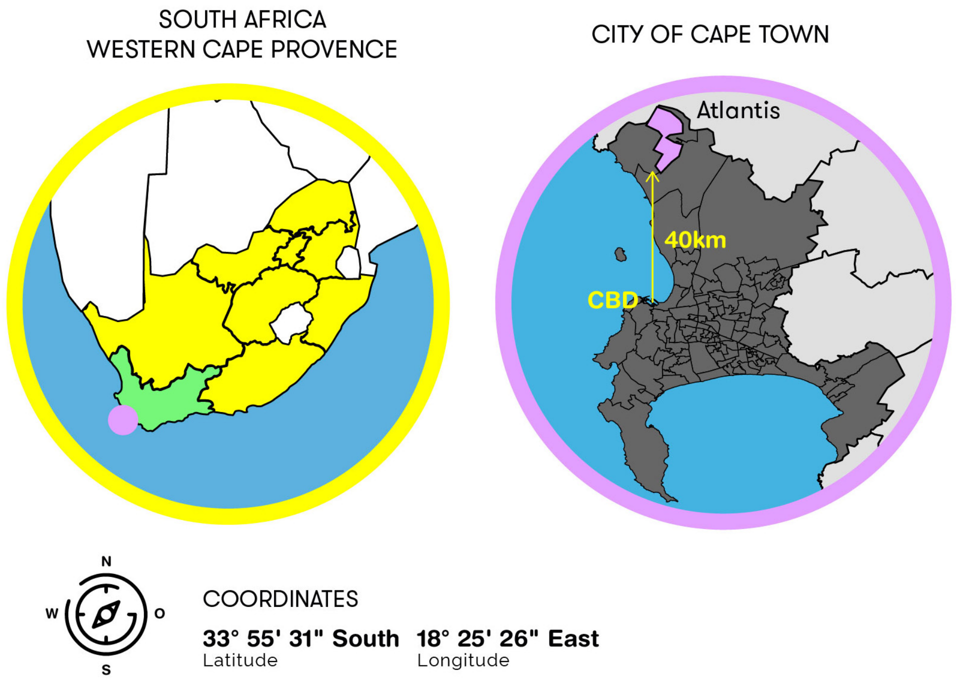


Figure 6.1 Atlantis, Cape Town South Africa, Coordinates.

6.1. Introduction

The decision to focus this study on the post-industrial precinct of Atlantis was because it is one of the most significant examples of African city-factory characterised by a relentless process of physical, economic and social degradation. Located in Cape Town capital of the Western Cape province (South-West South Africa), at 45 km north of the Cape Town CBD (Central Bussines District) the post-industrial precinct consists of 67.000 inhabitants across 28.84 km^2 (Figure 6.1)(Figure 6.2). Atlantis embodies an extreme case study to learn from, in which the narrative of segregation in post-industrial precincts corresponds with reality, and the spatial aspects of disconnection are more evident (Figure 6.3). On that view, was regarded an exemplary case to investigate as it was considered to be the heart of the Industrial cluster model for mass production in the history of South Africa (Nel & Meston, 1996). In order to understand the post-industrial morphology and legacy of Atlantis is necessary to introduce some background on the City of Cape Town (CoCT).

Since the XVII century, Cape Town's strategic geographical location brought a vast diversity of European colonisers such as the Dutch, Portuguese, and British, who brought with them slaves from different latitudes (mostly Malaysia and India). That fact shaped the current population on a diversity of ethnic groups, culture, languages and religions. Nevertheless, the discrimination between racial groups– Black Africans, Coloured[1], Indian and White – materialised even more during the apartheid regime.

Today, South African cities are the most segregated in the world at levels of race, space and now HIV-AIDS all aspects created by the legacy of apartheid which was an engineered and institutionalised system of racial inequality. These are so-called "the apartheid city" which were carefully planned and efficiently executed in order to segregate South African cities by race (Bruyns & Graafland, 2012). On that perspective, Cape Town is the ultimate representative "the apartheid city" due to its extreme spatial inequality and its unique topography and its unique racial composition (Figure 6.4)(Figure 6.5)(Figure 6.6).

1. Used as an ethnic label for people of mixed ethnic origin, including Khoisan, African, Malay, Chinese, and white. Source Oxford Dictionary 2020

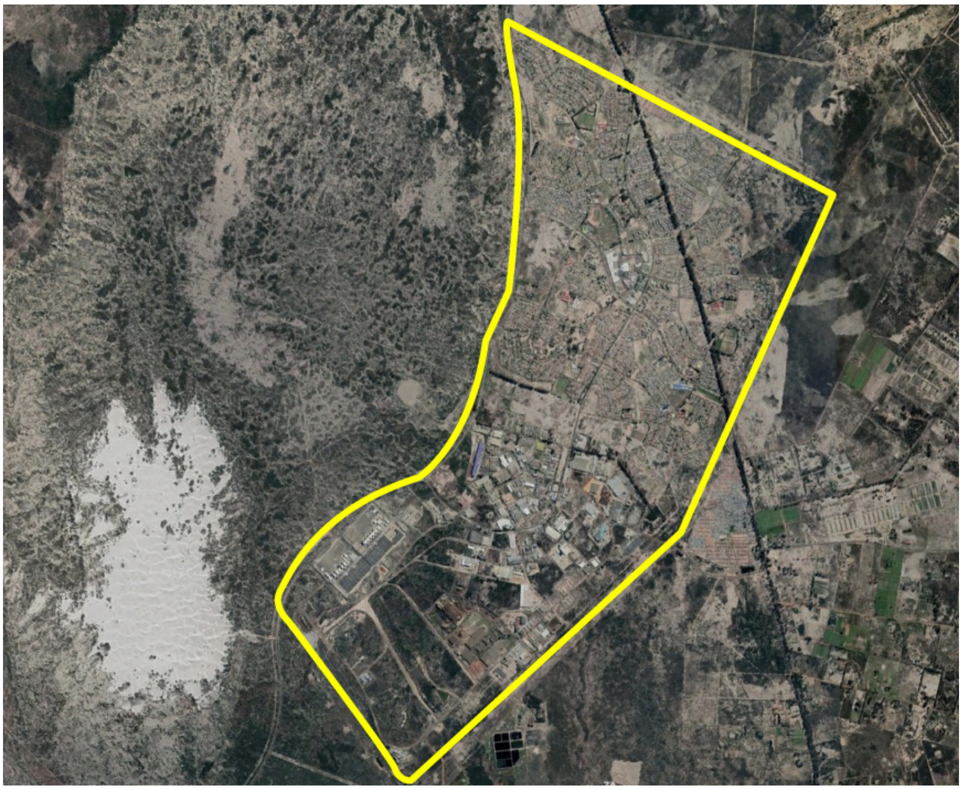
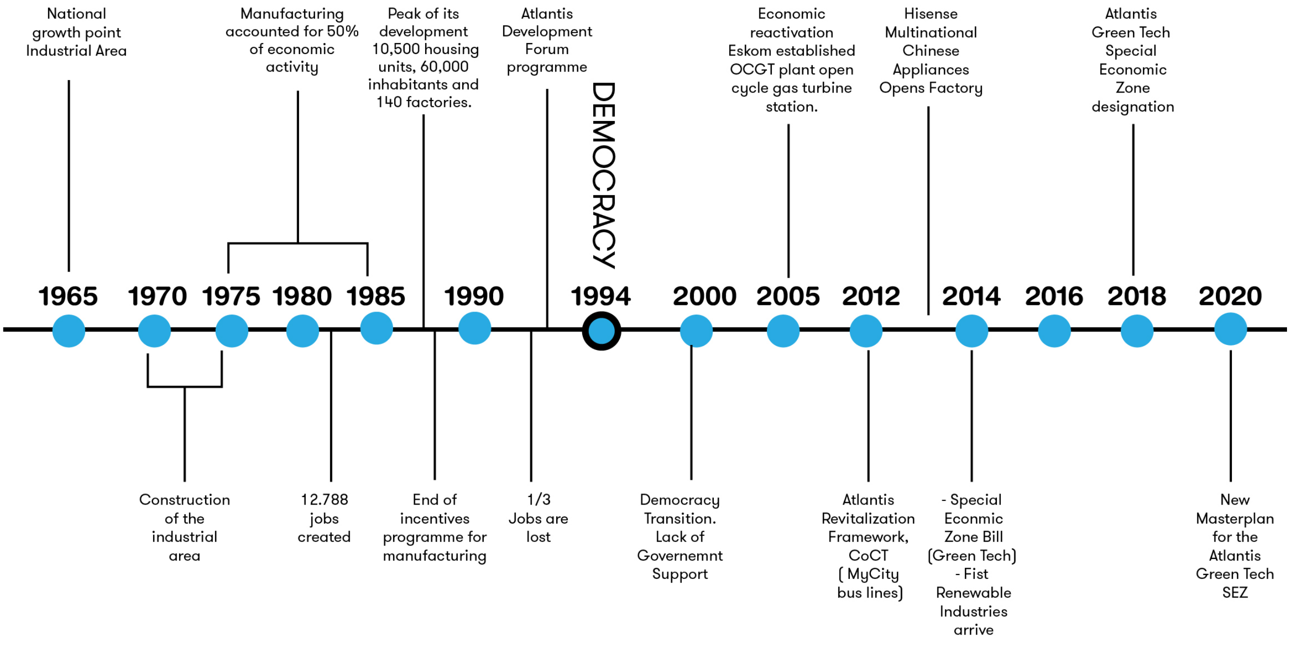


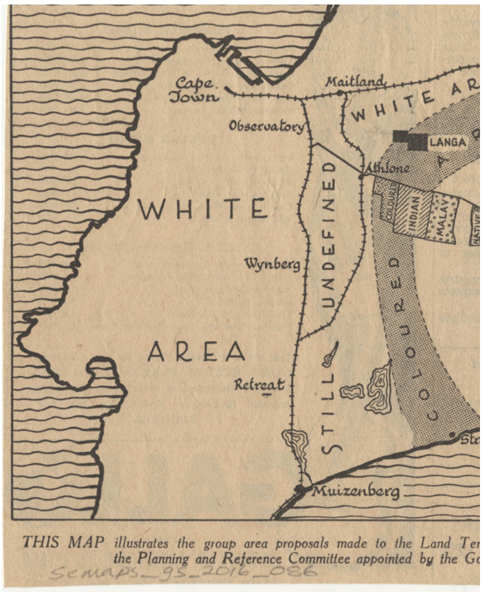
Figure 6.2 Atlantis, Cape Town South Africa.Courtesy of Google maps 2019.

Figure 6.3 Atlantis History timeline, event highlights.



The doctrine of apartheid ruled South Africa from 1948 until 1994 with the first multiracial democratic election where Nelson Mandela the leader of the African National Congress (ANC) was elected president, establishing the end of apartheid. As described by Pieterse (2006) the main spatial segregation pillars of the apartheid government's were the Population Registration Act of 1950, which rendered compulsory classification of the population into different racial groups: White, Black African, Indian and Coloured. Secondly, was the Group Areas Act of 1950 proposed to reach the complete segregation of society based on racial groups classified in the Population Registration Act, designated racial groups to different residential and business localities. An impact of the act was to ban non-whites from living in the most developed areas, which were assigned to Whites (Battersby-Lennard et al., 2009). All races except for white could stay in white-only areas exclusively for working reason, bringing a passbook official permit (Lemon, 1991) (Figure 6.7).

The process towards the apartheid city (Figure 6.4) implied forced removals of the non-white population out of white areas (Venter, 1999). As a result, thousands of people were relocated to ethnically segregated townships, where many found employment in the subsidised industry. An example is District Six were 60,000 of its inhabitants coloured



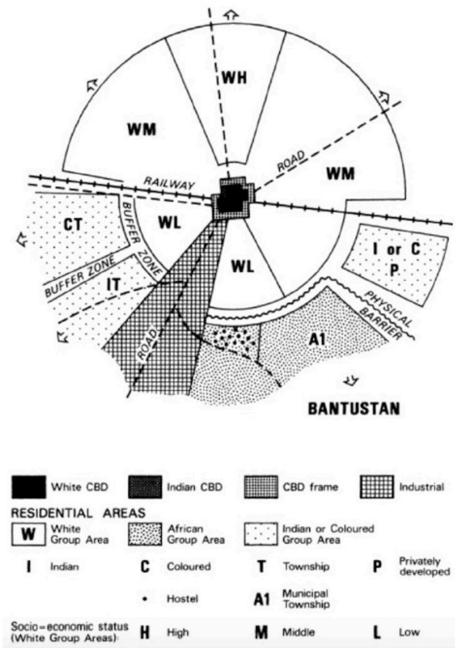
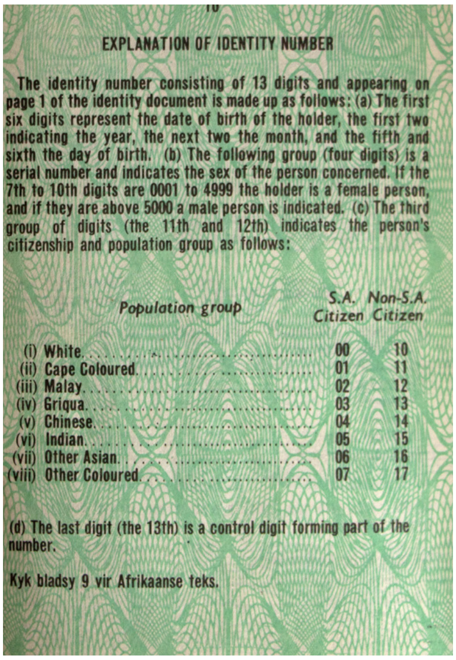


Figure 6.4 Early Apartheid Group area map Cape Town 1950, Courtesy City of Cape Town Historical archive.

Figure 6.5 Diagram of the spatial organization of the Segregation City by Professor R.J. Davies (The spatial formation of the South African city, in Geojournal Supplementary 2, 1981).

Figure 6.6 Apartheid Train Station entrances divided by race Cape Town 1950, Courtesy City of Cape Town Historical archive.



EXPLANATION OF IDENTITY NUMBER

The identity number consisting of 13 digits and appearing on page 1 of the identity document is made up as follows: (a) The first six digits represent the date of birth of the holder, the first two indicating the year, the next two the month, and the fifth and sixth the day of birth. (b) The following group (four digits) is a serial number and indicates the sex of the person concerned. If the 7th to 10th digits are 0001 to 4999 the holder is a female person, and if they are above 5000 a male person is indicated. (c) The third group of digits (the 11th and 12th) indicates the person's citizenship and population group as follows:

Population group	*S.A. Citizen*	*Non-S.A. Citizen*
(i) White	00	10
(ii) Cape Coloured	01	11
(iii) Malay	02	12
(iv) Griqua	03	13
(v) Chinese	04	14
(vi) Indian	05	15
(vii) Other Asian	06	16
(viii) Other Coloured	07	17

(d) The last digit (the 13th) is a control digit forming part of the number.

Kyk bladsy 9 vir Afrikaanse teks.

Figure 6.7 Apartheid South Africa identity card and race numeration.

Figure 6.8 May 13, 2019, International cover of TIME magazine examines South Africa as "the world's most unequal country." Photography by Johnny Miller.

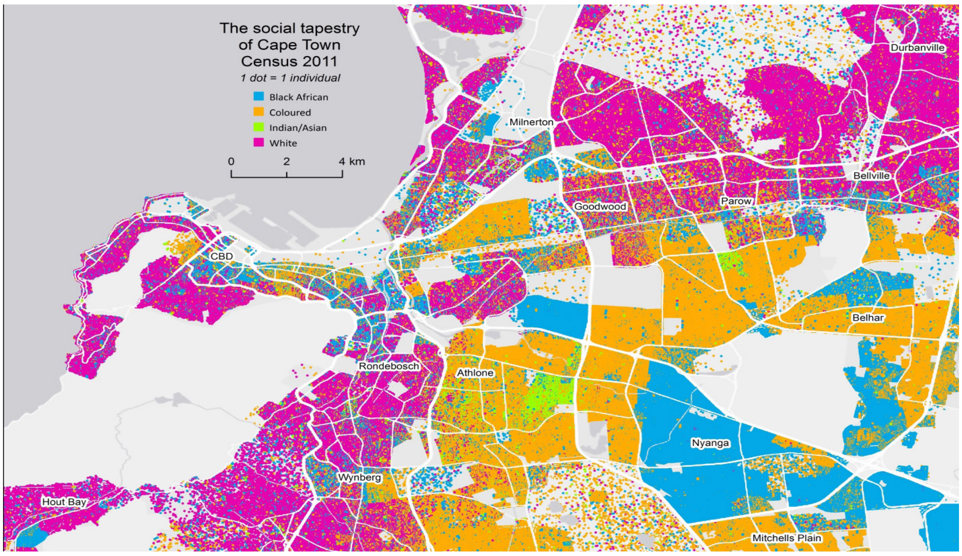
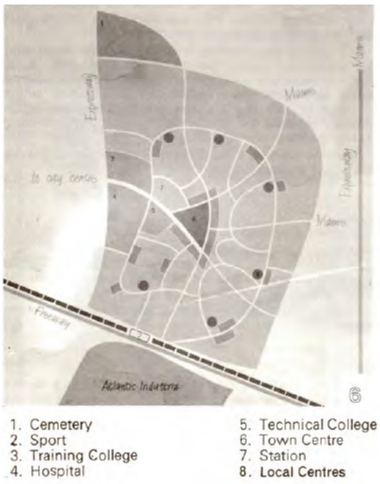


Figure 6.9 City of Cape Town density map by race 2011, Source; South Africa statistics.

Figure 6.10 Aerial view of central Cape Town after the demolition of District Six (foreground) 1950, Source; University of Cape Town. Libraries



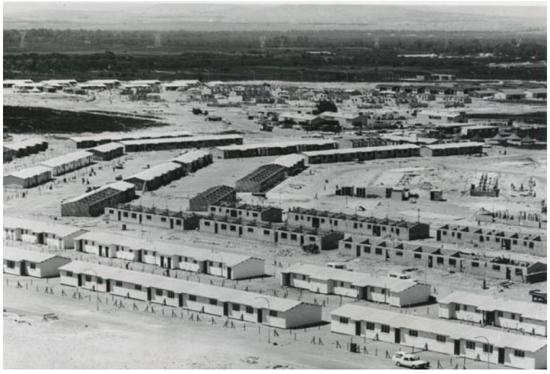


Figure 6.11 Atlantis precinct Apartheid planning draft. Source University of Cape Town. Libraries

Figure 6.12 Housing construction site on Atlantis Township 1975. Source: City of Cape Town historical archive .

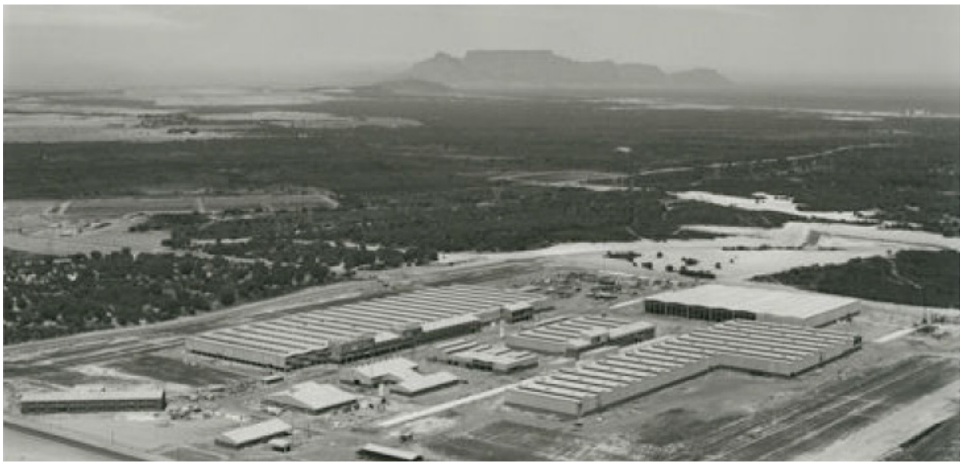


Figure 6.13 Atlantis Engine company 1978, Source; Independent News paper South Africa

Figure 6.14 Cape Town visible from the Atlantis 2018, Source Bruce Sutherland, City of Cape Town.

Figure 6.15 Atlantis industrial precinct 2019 , Source; Author

Figure 6.16 Atlantis Foundries inside industrial precinct 2019, Source; Author and black Africans were forcibly evicted, some of them relocated in Atlantis precinct (Figure 6.10).

The apartheid city model displays the segregation development scheme (Figure 6.4), where the centre of the city model is White, and the peri-urban area is assigned to Coloured, Indian and Black townships or also called artificial ethno-cities (Western, 1981; Pickles, 1991). The model implies that each area is separated with buffer zones, railway tracks, industrial precincts or physical barriers.

With that in mind, Atlantis precinct was established in 1965 as an industrial cluster and township for the coloured population of Cape Town (Ebrahim et al., 1986; FCR, 1992). The government launched several incentives in order to attract industry and residents to Atlantis, in terms of tax deductions and subsidies on electricity, transport, building, interest charges, and training (Western, 1981)(Figure 6.11)(Figure 6.12).

The precinct was to be a new town on a greenfield site. Construction began (1974-1975), following a structured plan for the new industrial township (Newton, 1988)(Figure 6.12). Atlantis precinct was a fundamental asset of the development axis between Cape Town and the new harbour town of Saldanha (Ebrahim et al., 1986). The industrial precinct opens in 1976, with a base of 60 companies supported by subsidies. Even though people of colour were not enforced relocated in Atlantis from Cape Town, the

Figure 6.17 Atlantis commercial precinct centre 2019 , Source; Author

Figure 6.18 Atlantis commercial precinct centre 2019, Source; Author

Figure 6.19 Atlantis commercial precinct centre 2019, Source; Author

69% of people had moved to the precinct because it was the only place in the province where they could find accommodation by 1986 (Newton, 1988).

In 1978, arrives a significant investment to construct the Atlantis Diesel Engine Company producing vital industrial support to the development of the industrial cluster (Figure 6.13). At the same time, the industrial sector was predominantly automotive, engineering and textile. Mainly the automotive industry was enrooted its linkages on national networked, whereas the textiles market fluctuation and foreign competition have severely endangered their survival (FCR, 1992). Since the beginning, Atlantis experienced the limitations of its location, at a distance of 45km from Cape Town it was considered too close for autonomous development but still extremely distant to help from the agglomeration influences of the metropolitan area (FCR 1992) (Figure 6.14)(Figure 6.15)(Figure 6.16).

Figure 6.20 Atlantis sprawl formal township housing 2019, Source; Author

Figure 6.21 Atlantis Informal settlements WITSAND Source; Google Views 2019

Figure 6.22 Atlantis sprawl formal township housing 2019, Source; Author

Figure 6.23 Atlantis industrial urban voids 2019 , Source; Author

Figure 6.24 Ankerlig plant open-cycle gas OCGT operated by Eskom, Source; Eskom archive

Figure 6.25 Atlantis main My City bus station 2019, Source; Author

Figure 6.26 Atlantis GRI Renewable Industries wind energy, first green industry of the Atlantis Greentech , Source Green Cape

Despite difficulties, the precinct developed at a gradually through the construction of social housing infrastructure. On that view, Atlantis by 1988 was at the top of its development with 60,000 inhabitants,10,500 housing units and 140 factories. At that point, there was a strong concern over the precinct's artificial nature and how resilient will be over time, relying only on government subsidies (Figure 6.17)(Figure 6.18)(Figure 6.19)(Figure 6.20)(Figure 6.21)(Figure 6.22).

On 1989 with the arrival of the apartheid political crisis, the government announces the end of the industrial incentives program, creating a massive impact in the precinct. As a result, 21 factories closed and the linked decline of 2,000 jobs in two years. Besides, the Atlantis Diesel Engine plant only kept 800 of its 3,000 workers. Consequently, one-third of total industrial jobs were lost by 1993 (Coetzee, 1992; FCR, 1992)(Figure 6.23).

Political tensions intensified the local circumstances; increasing unemployment and disillusionment hopelessness set in, giving way to alcoholism, drug abuse, gangsterism, and crime, developed a profound crisis Atlantis (ADF, 1993). Therefore in 1991, the Atlantis Development Forum, the gathering was called embodying all unions, political parties, local authorities, community and business groups, in order to develop an Urban Development Plan within a Local Development program (FCR, 1992). The program implemented actions in 1994 to support the local economy and community such as the Atlantis Business Information Centre, the community radio Atlantis, industrial training programs, social housing plans and Atlantis Peoples Centre (community centre) (LSP, 1995) (FCR,1993). However, despite the government plans, they were never accomplished or reached rather modest outcomes, that increased the high levels of frustration and lack of trust from the local population towards the government (Nel & Meston, 1996).

Across the 2000s', the government focused on several re-industrialisation projects to bring industry again and generate resilience in the livelihoods of the precinct. On that view, Atlantis has several attempts of economic reactivation such as the opening of a massive plant open-cycle gas OCGT by the national electricity provider Eskom (Figure 6.23). Such attemps for regeneration did not delivered a long-term solution.

Once again in 2011, the CoCT government launch an Atlantis Rehabilitation framework were the significant achievement for the precinct was the arrival of the Integrated Public Transport network MyCiti (bus rapid transit BTR) service, which for the first time connected the precinct with the city. (Figure 6.25)

In 2015 the CoCT supported an initiative to establish a green technology Special Economic Zone (SEZ) in Atlantis. In order to pave the way for a Greentech SEZ was to establish a Greentech industrial park in Atlantis. For that purpose, the CoCT provided 101 ha of land of vacant/deprived ex-industrial to promote the revitalisation of Atlantis as a strategic development node. Also, the revitalisation operation would entail a re-engineering of current industry clusters and assistance for upcoming Greentech businesses. On that view, the Greentech hub aims to encourage CE strategies within the existing manufacturing sectors to become suppliers and component manufacturers for the upcoming green industries. In the framework of the SEZ, the CoCT approved several incentives to attract investors. The project was commissioned by the South African Department of Trade and Industry (DTI) to the Sector Development Agency on Greentech - The GreenCape to facilitate the establishment of Greentech SEZ in Atlantis. This work is a collaborative enterprise between the CoCT, DTI, Western Cape Government and WESGRO (Trade & Investment Promotion Agency for Cape Town and the Western Cape)(GreenCape, 2020).

On 2018 the Atlantis Greentech SEZ was officially launched by President Cyril Ramaphosa. The precinct was declared to be the first green hub of Africa a Special Greentech Economic Zone, including not only industry but all of the stakeholders and inhabitants with the purpose to transform it on the first circular precinct of Africa (GreenCape, 2020) (Figure 6.26)

Nevertheless, several scholars have argued *"Atlantis is a microcosm of South Africa; it is an amplification of the national problem of high unemployment . . . Atlantis was a creation of apartheid, and it: has taught us that planning interventions can go wrong"* (Nel & Meston, 1996) or *"one of the most expensive social disasters ever created in the country"* (Ebrahim et al., 1986). Atlantis reflects in South Africa's experiment with the concept subside industrial clusters forerunner to SEZ developments. The failed experience of not being able to retain industrial investors within the area needs to be instructive to the current SEZ concept. On that view, the critical lesson is that for Atlantis to become economical, social and environmentally sustainable, it is essential to develop the area within a systemic transition with a strong emphasis on value creation who can develop local value chains and are reliant on local know-how and labour networks.

For this examination, the researcher worked in a close partnership with the Government agencies the GreenCape and WESGRO. The precinct examination of this research project through systemic design aimed to influence the decision-making process on the current Master Plan developed by ARUP consulting. The results of this study aim to facilitate a better un for the area understanding of the potential CE strategies for a resilient Circular City model on a Global South perspective. In order to execute the study, the researcher was based for five months of field research in Cape Town South Africa between 2018 and 2019, as in inhouse visiting researcher at GreenCape agency.

	METHOD STEPS	OBJECTIVES	RESULTS
1	**Holistic Diagnosis**	To deliver a holistic system panorama of all Atlantis's post-industrial precinct assets.	-Data Collection (Desk and Field research) -Visualization of the complex data collected. -Identification of Policy framework and Map of stakeholders. -A common understanding of the current state of the art of Atlantis'
2	**Definition of problems and leverages for change**	To identify the current local assets from opportunities to challenges as leverages for value creation.	-A critical overview of the local assets, in order to target the local assets that could serve as potential levers for circularity. -Awareness of holistic challenges issues in Atlantis precinct that hamper circularity but could represent an opportunity. (challenges into opportunities) -Awareness in opportunities that foster a Circular City model in Atlantis precinct. - A shared understanding of the current levers presents on Atlantis that could support future CE strategies on a Circular City model.
3	**Design the system**	To Co-design the current system based on the conceptualisation of a Systemic approach on Circular City framework.	-Atlantis' local levers reframed in relation to the Circular City framework. -Challenges and opportunities targeted by single or several Circular Actions, towards local value creation.
4	**Outcomes Evaluation**	Need of a long-term vision of multi-governance policy strategies	-Refined the main Circular Actions into targeted strategies for value creation in Atlantis precinct. -Awareness of Circular Actions that involved more local levers. (Circular Action that activates a Circular City model).
5	**Implementation**	To establish system dynamics through concrete implementations for each strategy potential or already executed	-Opportunity for each strategy within a short- and long-term perspective. -Awareness of cross-cutting action implementation. (relation among actions should generate a systemic dynamic). -Systemic implementation of a Circular City model in Atlantis precinct. (that should create local value and deliver more realistic and feasible new economic, environmental and participatory activities)
6	**Results analysis and feedback**	To assess the proposed Circular Actions through the lens of the Circular Economy Barriers and impact indicators.	-The indicators provide a useful political tool for monitoring progress to allocate funds to Circular Actions in Atlantis precinct. (co-creation of circular economy policies) -Ensure continuous evolution towards an autopoietic Atlantis precinct (aa Circular City model transition). -The feedback analysis advises potential problems generated by adopting these actions or collateral effects.

Table 6.1 Atlantis examination study, method

6.1.1. Aim and Objectives

This study aimed to develop the Systemic Design Framework for Circular Cities in Post-industrial precincts and co-design Circular City model decision-making process in Atlantis precinct. To that aim, the following objectives were set:

1. To deliver a holistic system panorama of all Atlantis's post-industrial precinct assets.
2. To identify the current local assets from opportunities to challenges as leverages for value creation.
3. To Co-design the current system based on the conceptualization of a Systemic approach on Circular City framework.
4. To identify potential or executed strategies around the main Circular Actions (Regenerate, Adapt, Loop).
5. To establish system dynamics through concrete implementations for each strategy potential or already executed.
6. To assess the proposed Circular Actions through the lens of the Circular Economy Barriers and impact indicators.

6.2 Project Method

Applying established in the Systemic Design Framework for Circular Cities (Figure 4.4) the examination study was carried in 6 steps, each one targeted a specific objective and generating results (Table 6.1).

6.3 Holistic Diagnosis

The first stage of this research aimed to deliver a holistic system panorama of all Atlantis post-industrial precinct asset. To achieve that this research project applied a structural and organised process to elaborate, create, generate, configure, draft, and perform the Holistic Diagnosis. As explained in section 3.8.1.1, in order to frame and reveal problems efficiently in this Atlantis precinct case study the approached stages were; Assess, Research, Collect, Visualise, Interpret (ARCVI)(Figure 3.3).

The "assessment" first stage defined the scope previously settling the system boundaries within the Atlantis precinct and determined by its political, geographical and cultural edges (Figure 6.1). In addition to this system boundaries, the applied framework scoped this research investigation within a Circular City model lens.

So, in order to deliver the objective set in (Table 6.1) "a holistic system panorama of all Atlantis's post-industrial precinct asset" the Holistic Diagnosis considered within the Atlantis precinct the three main components already explained in section 3.8.1.1 which are; Data categories, Stakeholder Identification and Policy Framework Analysis. To explain how the components were approached within the stages (ARCVI), this section will be divided into two parts. First, it will be approached the "Research and Data Collection" and afterwards the "Visualise & Interpret" stages.

6.3.1 Research & Data Collection

The research and data collection stage were undertaken according to the mixed-method approach adopted by this investigation (see section 3.4 research strategy). Therefore, as specified in section 3.9.1.2 on the Atlantis precinct examination was applied data collection methods such as; desk research (quantitative method) and field research (qualitative method).

On that scope was approached the research and data collection for the three components of Atlantis's Holistic diagnosis. On the following section, it will be approached the re-research and data collection stage of each one of the components; Data categories, Stakeholder Identification and Policy Framework analysis. Moreover, is essential to underline that the researcher approach in the three components in this stage simultaneously.

6.3.1.1. Data Categories

The data categories for the examination of Atlantis precinct were defined and further explained in section 3.8.1.1 (urban fabric, demography, economy, culture) (Figure 3.4). This section specifies the sources and methods of these categories for the research and data collection of Atlantis precinct.

As this research project for the Atlantis precinct was supported by the government agency The GreenCape, the Desk research method got a considerable amount of the data as city authorities provide accessibility to the municipal and national databases. In the following (Table 6.2), are the primary sources and entities to gather the data each category focusing on description and challenges of the process.

After establishing all of the sources and research methods for each category, the data collection was set assembling the data gathered in these categories. In the case of the Atlantis precinct examination, the data was organised inside the format established in the framework assessment step (Annexes II). The information included references for each data in order to guarantee accuracy inside the analysis enabling tracing of information at all times. This organisation supported the researcher in further steps with a unified database outcome.

In this particular case study, some of the categories of the format presented in Annexes II are slightly different from the ones in Annexes I. The reason for these minor differences is related to the data available in each scenario.

Parallel to this, field research was executed between 2018-2019 within the Atlantis precinct, mainly to verify with observations and vivid descriptions of the qualitative data collected at the desk research. Through these sites visits, it was registered the current- state of the art, which allowed the researcher to verify the data gather in the desk research (Figure

Table 6.2 Database sources and entities to gather the data each category focusing on description and challenges of the process.

	DATABASE	ENTITY	OBSERVATIONS
Urban Fabric	**Census data Statistics South Africa**	Statistical office of the South Africa	Government databases provided most data sources for this category. -In case data was not available at the precinct level, the data was approached at levels of city. -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. -Particularly the case of household waste management it was only provided at city level. -The units among databases were always not uniformed or presented in unit required. -Difficult accessibility. (lack of cooperation with civil servants). -Some data was not available for the precinct (was consider a city-level perspective). -The interface of the databases was challenging for research purposes.
	Strategic Development Information and GIS Department (SDI & GIS)	City of Cape Town	
	Municipal Spatial Development Framework	City of Cape Town	
	2019 Waste Market Intelligence Report	The Green Cape	
	Growth and density maps	African Centre of Cities Integration Syndicate	
	Energy Market intelligence Report 2018	The Green Cape	
	Master Plan Atlantis SEZ	Arup / The Green Cape	
Demography	**Census data Statistics South Africa**	Statistical office of the South Africa	-Government and Research centres databases provided most data sources for this category. -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. -Particularly the case of Demographics, most of the databases, are divided by race. -Data was last updated ten years ago. -Difficult accessibility. (lack of cooperation with civil servants). -Some data was not available for the Precinct (was consider a city-level perspective). -The interface of the databases was challenging for interpretation purposes.
	Strategic Development Information and GIS Department (SDI&GIS)	City of Cape Town	
	DotMap Density population South Africa	African Centre of Cities Alan Firth	
	Atlantis Green economy skills audit 2019 report	Altgen- GreenCape	
	Crime statistics	South African Police	
	Western Cape Mortality Profile	Western Cape Province	
	Atlantis Deloitte SWOT (2018)	Deloitte / The Green Cape	
Economy	**Business Directory**	CoCt Atlantis Investment Facilitation Office	-Government and local databases provided most data sources for this category. -In particular, Green Cape possessed most of the Industrial census state of the art -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. -Particularly the case of the industrial waste management, the WISP team, provided data, and the researcher was able to execute some field research to verify the data. -The units among databases were always not uniformed or presented in unit required. -Difficult accessibility. (lack of cooperation with civil servants). -Some data was not available for the Precinct (was consider a city-level perspective). -The interface of the databases was challenging for research purposes.
	Strategic Development Information and GIS Department (SDI & GIS)	City of Cape Town	
	Western Cape Industrial Symbiosis Programme (WISP)	Western Cape Industrial Symbiosis Programme (WISP)	
	2019 Waste Market Intelligence Report	The Green Cape	
Culture	**Census data Statistics South Africa**	Statistical office of the South Africa	-This category was the most challenging to get data; some government databases provided data sources. However, the researcher was able to do some informal interviews with cultural leaders of the precinct. As there is few written source about the Cultural aspects of Atlantis. -Some of this data, even though it is open to the public, city agencies, will provide the data only under a request of research or project request. -Some data sources were in the Afrikaans language -The units among databases were always not uniformed or presented in unit required. -The interface of the databases was challenging for research purposes.
	Strategic Development Information and GIS Department (SDI & GIS)	City of Cape Town	
	Business Directory	CoCt Atlantis Investment Facilitation Office	

6.15)(Figure 6.16)(Figure 6.17)(Figure 6.18)(Figure 6.19)(Figure 6.20)(Figure 6.22)(Figure 6.23). In the following section, a full description of both desk and field research will be elaborated.

The system outcomes of this data collection gathered in (Annexes II) will be interpreted and visualised in the following section.

6.3.1.2 Policy framework

The research and data collection for the Atlantis precinct was executed as under the parameters described in section 3.8.1.1.; also, it was entirely conducted through a Desk research approach (see section 3.8.1.2). Moreover, the analysis of Atlantis was firmly rooted in the construction of a more systemic approach that included bottom-up and top-down definitions (Krauz, 2016)(Figure 3.6), creating a panorama from current policies to grassroots actions regarding axes related to CE.

In order to reach a complete perspective on top-down approaches on Atlantis precinct, the researcher was supported by the government agencies The GreenCape and who provided the documentation about all policies and programs applied in the area regarding axes related to CE on the last 30 years such as; city Master Plans, regeneration programms, environmental strategies, re-industrialization plans and specific funded projects. This data was relevant to understand what top-down approaches successful and which ones have failed, mostly comprehend the reasons why. This panorama is vital for further stages in the examination of this case study.

In the other hand, for a complete panorama of the bottom-up approaches in Atlantis precinct, The GreenCape connected the researcher with Atlantis Council of Stakeholders (ACOS) which is a board of all community representatives including leading third sector organization of the precinct.

On that view, the ACOS provided the researcher documentation about all grassroots actions and programs active in the area regarding axes related to CE. This data was relevant to understand how bottom-up approaches are delivering a state-of-the-art on the potentialities and challenges of local stakeholder interactions. Whose activities sometimes have built a more effective citizen-public administration relationships, promoting local development through actions on social innovation, entrepreneurship, health, food security, and cultural heritage.
The data collection of the top-down and bottom-up approaches in Atlantis precinct was synthesized in Table 6.3. In order to render this scouting valid for the next phases of analysis, the findings were categorized under the previously stated categories -urban fabric, demography, economy, culture-.

The overview of the Atlantis precinct Policy Framework delivered a state-of-the-art of the past-present and future regenerative actions on the social, economic and environmental aspects- highlighting the significant strengths and weaknesses.

From a top-down perspective, these instruments address regeneration as a multidimensional concept containing economic development, employment opportunities, services effectiveness, cultural and social regeneration, inclusion. These actions have to do with the economic dimension of sustainability from Greentech SEZ Atlantis to the Investment Facilitation programme. They aimed to reach opportunities offered by innovation through more efficient use of resources, creating socio-economic welfare. In particular, Atlantis precinct since the begging of its decline in the city government has stimulated a series of policies for regeneration, entrepreneurship and social cohesion from the Atlantis Development Forum 1991 to the Atlantis Rehabilitation framework 2011, both with modest results. Other coordinated actions focused on an integral perspective of the precinct within the CoCT integrating efficiency of use of natural resources, but also landscape restoring and rehabilitation and sustainable economic models are; CoCT Municipal Spatial Development Framework (2018), CoCT Urban Settlement Development Grant Funds, CoCT Social Development Strategy and Integrated waste management plan, CoCT (2017). Nonetheless, these traditional regeneration instruments require to coordinate new forms of social inclusion of the

Table 6.3 Policy Framework analysis scheme

	TOP-DOWN	BOTTOM-UP
Urban Fabric	-**CoCT Municipal Spatial Development Framework (2018):** sets out the spatial vision and development priorities to achieve a reconfigured, inclusive spatial form for Cape Town. -**Integrated Resource Plan (Department of Energy, 2011)**; Co-ordinated schedule for generation expansion and demand-side intervention programmed, taking into consideration multiple criteria to meet electricity demand. -**National Strategy for Sustainable Development** (Department of Environmental Affairs, 2011); a proactive strategy that regards sustainable development as a long-term commitment, which combines environmental protection, social equity and economic efficiency with the vision and values of the country. -**National Climate Change Response (2011)** -**CoCT Resilience strategy (2019):** The strategy is a roadmap for which aims to strengthen the city against sudden potential shocks in future, from storms and heat waves, global financial crises and other unforeseen challenges. -**CoCT Urban Settlement Development Grant Funds***:* a government fund for municipalities for the built environment to the development of sustainable cities. -**Atlantis Community Rural Development Programme:** The government aims to deal with rural poverty effectively through the optimal use and management of natural resources through an integrated agrarian transformation and the strategic investment in economic and social infrastructure that will benefit rural communities.	-**Atlantis Small Farm Association:** Community association develops a program for rural farming.(Figure 6.27)
Demography	-**CoCT Social Development Strategy:** combines the role of the City in promoting and maximizing social development, addressing poverty, inequality and social ills while providing for the participation of people in their development. -**Atlantis Skills development program:** The Atlantis skills development programme aims to empower residents and young people of Atlantis with valuable skills so that they can tap into the job potential in the proposed Atlantis SEZ. (Figure 6.30) -**Atlantis Community Police Forum***:* consists of organizations and institutions such as schools, ratepayers associations, civic organizations, businesses and religious institutions, working in partnership with the local police, to create and maintain a safe and secure environment for citizens living in Atlantis.	-**Atlantis SEZ Community Stakeholder Network**: is a community structure which was elected by Atlantis stakeholder structures and their respective representatives. The ASEZ-CSN spans eight defined sectors within the Atlantis community. (Figure 6.28) -Ikamava Youth: Project offering after-school tutorial support, mentoring and career guidance for young people from the suburbs of large cities. (Figure 6.30) -**Atlantis Alive Youth for Christ:** Social Services, Youth services and youth welfare, Services to youth, includes delinquency prevention services, teen pregnancy prevention, drop-out prevention, youth centres and clubs, job programs for youth, includes YMCA, YWCA, Boy Scouts, Girl Scouts, Big Brothers/Big Sisters -**Faith Soup - Kitchen project:** Income Support and Maintenance, Material assistance, Organisations providing food, clothing, transport and other forms of assistance, includes food banks and clothing distribution centres. . (Figure 6.31) -**G-Force Arts and Culture Programme**: Social Services, Child welfare, child services, daycare, Services to children, adoption services, child development centres, foster care, includes infant care centres and nurseries -**Orion Organisation***:* Social Services, Services for the disabled, Services for the disabled; includes homes, other nursing homes; transport facilities, recreation and community greenery. (Figure 6.32) -**United Sanctuary social cohesion association, From Scars to Stars youth association, Child Welfare Mamre, Atlantis Family Focus**: awareness-raising programmed around issues such as substance abuse, services, disability and elderly abuse. -**DreamTeam Committee:** Economic, Social and Community Development, Community and neighbourhood organizations, Organisations working towards improving the quality of life within communities or neighbourhoods - e.g., squatters' associations, local development organizations, poor people's cooperatives. (Figure 6.33) -**Concerned Citizens of Atlantis,- Mamre Council of Stakeholders -Atlantis Council of stakeholders- Witsand consent residents***:* Residents associations groups
Economy	**-Greentech SEZ Atlantis***:* Greentech industrial park in Atlantis (Special Economic Zones Bill in Government Gazette No. 36203 of 1 March 2013 (Department of Trade and Industry, 2014); -**Ten Year Innovation Plan***, 2008 – 201*8 (South Africa Department of Science & Technology); technology transfer program for green technologies. -**Atlantis Investment Facilitation programme:** Strong support for the Greentech sector in government policy. Support local manufacturing of Greentech include Renewable energy Independent power producer procurement programme. -**Black Economic Empowerment Model***: government policy* to advance economic transformation and enhance the economic participation of Black people (African, Coloured and Indian people who are South African citizens) in the South African economy. (it involves measures such as Employment Preference, skills development, ownership, management, socio-economic development, and preferential procurement)	-**Atlantis Economic Development Trust**: Economic, Social and Community Development, Social Development, Organisations working towards improving the institutional infrastructure and capacity to alleviate social problems and to improve the general public well being. -**Saxon Sea Community Developments Project:** Economic, Social and Community Development, Community and neighbourhood organizations, Organisations working towards improving the quality of life within communities or neighbourhoods - e.g., squatters' associations, local development organizations, poor people's cooperatives -**Hartebeeskraal Multi-Purpose Community Centre**: Economic, Social and Community Development, Social Development, Organisations working towards improving the institutional infrastructure and capacity to alleviate social problems and to improve the general public well being -**Atlantis Unrestricted Workers Association** - Atlantis Informal Traders: associations to support informal workers. (Figure 6.34)
Economy	-**CoCt Atlantis Investment Facilitation Office:** ***c***reates and enhance the enabling economic climate and business environment in the broader Atlantis area, in order to promote economic growth, job creation and wealth generation. -**Atlantis Business Chamber***:* to create an environment for business, government and community to improve local economic investment. -**Atlantis Unions***:* South African Federation of Trade Unions Congress of South African Trade Unions - South African Clothing & Textile Workers Union - National Union of Metal Workers. -**Western Cape Industrial Symbiosis Programme (WISP)** a government platform that connects companies so that they can identify and realise the business opportunities enabled by utilising unused or residual resources, enhancing business profitability and sustainability. -**South African Renewable Energy Incubator (SAREBI)** *:* established in 2012 by the Small Enterprise Development Agency Technology programme (SEDA) to incubate businesses in the renewable energy sector	

	TOP-DOWN	BOTTOM-UP
Culture		-**Griqua Royal house**: *Association* that promotes and preserves the Griqua mixed race culture. (born in Cape Colony of South Africa, around the 17th and 18th Century). (Figure 6.35) -**Khoi-san renaissance cultural awareness:** *Association* that promotes Khoisan Renaissance Cultural Awareness is all about creating a platform where Brown/Khoisan Aborigines of S.A can connect with, embrace and celebrate their ancient culture and language. (Figure 6.35) -**Atlantis First Indigenous peoples community**: Civic organisation that promotes the rights and culture of indigenous people. (Figure 6.35) -**Faith Tabernacle Ministries - Witsand Ministers Fraternal**: Religious Congregations and Associations, Congregations, Churches, synagogues, temples, mosques, shrines, monasteries, seminaries and similar organizations promoting religious beliefs and administering religious services and rituals

community and stakeholders to activate public and private resources. This research found that this aim has been enrooted in most top-down initiatives; however, the approach has not been successful. Notably, the researcher could not find national or city policies that enhanced or support the local heritage. Hence, this research observed four actions are trying to gain this coordination through the promotion of CE. On a macro perspective there is the CoCT Resilience strategy (2019) which aims to coordinate actions towards a social, economic and environmental resilience in the city, influencing of course Atlantis. On a local level, the predominant strategy is the upcoming Greentech SEZ Atlantis that aims to create the first green hub of Africa. In order to be activated, the Greentech SEZ is essential to develop local "green skills" through the Atlantis Skills development program. Also, Western Cape Industrial Symbiosis Programme (WISP), has examined the potential synergies of the material flows of the Atlantis precinct.

From a bottom-up panorama, it is clear that actions have a considerable higher impact, as they targeted interaction with citizens from a coloured community perspective (coloured township). This research identified the relationships generated between the local and government actions as a critical asset. These grassroots actions are the most relevant of an entire network of 60 entities of the third sector present in the precinct. Their aim is to co-plan services and management of collective assets which facilitate the involvement and active participation of citizens, encouraging the inclusion of all the groups of communities involved in the process, with attention to the weaker groups.

The more representative is the Atlantis SEZ Community Stakeholder Network which represents all sectors of the community and could empower the weak sense of belonging as a catalyst for initiatives that provide active participation of citizens. In order to in the co-design and implementation of interventions for the redevelopment and regeneration of collective spaces. Whose activities have built a more effective citizen-public administration relationships and promoted local development through actions on social innovation, entrepreneurship, health, food security, and cultural heritage.

Most of the bottom-up actions are related to the demographic aspect of social cohesion and vulnerable population. In particular, this is due to high levels of violence in the precinct a result of unemployment and alcoholism. On that view, there is a strong presence of youth organization to avoid gangsterism and unemployment phenomena.

Even though the social panorama is critical and depressed some actions have proof that local, sustainable development strategies can be blended successfully with the community as an example; Atlantis Small Farm Association (rural indigenous farming), Faith Soup - Kitchen (urban farming and local kitchen) and Orion Organisation (community greenery for disabling population).(Figure 6.27)(Figure 6.31)(Figure 6.32)

The mapping of this policy scenario in Atlantis allows having a better comprehension of the role of all local actors essential for the development proposals grounded in the local context. Also, it created a multi-stakeholder dialogue which can support a CE policy transition and bottom-up process effectively.

Figure 6.27 Atlantis Small Farm Association 2019- Source Author

Figure 6.28 Atlantis SEZ Community Stakeholder Network meeting July 2019 -Source Author

Figure 6.29 Atlantis renewable energy challenge in schools part of the awareness activities, Atlantis Skills development program August 2019 - Source Author

Figure 6.30 Atlantis Ikamava Youth awareness activities -Source Atlantis Ikamava Youth

Figure 6.31 Atlantis Faith Soup –Community Kitchen - Source Atlantis Faith Soup

Figure 6.32 Orion Organisation community farming activities - Source Orion Organisation

Figure 6.33 DreamTeam Committee after school program- Source DreamTeam Committee

Figure 6.34 Atlantis Unrestricted Workers Association-Atlantis Informal Traders - Source Author 2019

Figure 6.35 Researcher meeting with Atlantis First Indigenous peoples community, Khoi-san renaissance cultural awareness, Griqua Royal house leaders -Source Author 2019

6.3.1.3 Stakeholder Identification

The Stakeholder Identification of the Atlantis precinct was executed as described in section 3.8.1.1, this process was build based on the findings of Data Categories and Policy Framework Analysis described above.

Based on the Systemic Design principles the stakeholder identification on the Atlantis Precinct required to active cooperation with a quadruple helix model which implied governments, industries, communities and research institutions (Figure 3.7) (Barbero, 2017). For this reason, the researcher engaged with critical local partners to reach a more comprehensive engagement process on mapping and selection of stakeholders, that can influence the transition to the CE in public administration, business, associations, education and civil society (Ferrulli et al., 2019).

Table 6.4, summarises the stakeholder selection based on a mutuality perspective, identifying a description the relevance of the research project for targeted stakeholder and, at the same time, the benefits stakeholders could gain from this examination.

On a first approach, the researcher identified the "lead stakeholders" for each category; City of Cape Town (government), Wesgro (industries), Atlantis SEZ Community Stakeholder Network (communities) and the GreenCape (research institutions) (see Table 6.4). This identification was followed upon a scoping activity, involving desk research, visits to key the lead stakeholders, roundtables and informal discussions aimed at assessing a whole identification process of stakeholders involved in a Circular City model.

Table 6.4 presents the mapping of the main stakeholders involved in this research project. Such systemic perspectives aimed to foster participatory methodologies that could trigger value creation and innovative processes of sharing knowledge and experiences among different stakeholders and can build circular innovation in the public sector (Jones, 2018). For that aim, the involvement of the lead stakeholders in Atlantis precinct was essential to ensure the participatory development of a system perspective on quadruple helix perspective. This configuration was able to the cooperation between the researcher and GreenCape who facilitate the contacts for this research. This analysis unveiled the panorama of all stakeholders required to conceive a holistic and resilient vision of a Circular City model for Atlantis precinct.

Table 6.4 Atlantis precinct Stakeholder analysis scheme

QUADRUPLE HELIX	STAKEHOLDERS	DESCRIPTION
Community	**Atlantis SEZ Community Stakeholder Network** *Lead stakeholder*	The Atlantis Special Economic Zone Community Stakeholder Network (ASEZ-CSN) is a community structure which was elected by Atlantis stakeholder structures and their corresponding representatives. The ASEZ-CSN spans eight defined sectors within the Atlantis community, including unions, cultural groups, industry, commerce, among others. This network supports public participation process around the Atlantis SEZ and precinct development.
	60 Third Sector organizations	Atlantis precinct has over 60 ONG organizations that support grass-roots initiatives in the areas of Community, Economic Development, Education, Territory, Culture, and Social inclusion
Industry	**WESGRO (Trade & Investment Promotion Agency for Cape Town and the Western Cape)** *Lead stakeholder* wesgro cape town & western cape tourism, trade & investment	Industry agency that supports companies, leading critical strategic initiatives, to contribute to the cities growth and development not only economic. Wesgro assists investors and businesses looking to branch out into the province. In Atlantis, they are the one the critical representatives for the development of the Atlantis SEZ.
	Atlantis Economic Development Agency *(Business SMME)* **South African Renewable Energy Incubator** *(SAREBI)* **Atlantis Business Chamber** *(Business SMME)* **Atlantis Industrial Initiative** *(Business Industry)* **Luphulo Atlantis Business Development Forum** *(Business Informal & Cooperatives*	These local agencies represent all the industrial and economic sectors that are present in Atlantis such as the SMME, manufacture, cooperatives and informal sector.
Research	**The GreenCape (Sector Development Agency on Greentech)** *Lead stakeholder* GreenCape Supporting the business of green	Government Sector Development Agency supports and promotes the green economy- low carbon, resource-efficient and socially inclusive - in the Western Cape, South Africa. This agency assists businesses and investors, focusing on green technologies and services to remove barriers to their establishment and growth. They were appointed by the South African Department of Trade and Industry to manage and technically advice the upcoming Atlantis Greentech SEZ.
Government	**City of Cape Town** *Lead stakeholder* CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	For this research, the CoCT was involved through different offices that currently are more involved in the upcoming Atlantis SEZ Greentech. Such departments are: -Atlantis Investment Facilitation Office -Spatial Planning and Environment Directorate -Catalytic Sectors, Enterprise and Investment Department -Economic Opportunities and Asset Management Directorate

Furthermore, this stakeholder network will later serve on the development of the theoretical framework on the implementation, feedback of the new CE strategies and creation of a supportive background for the transition toward a Circular City model. This mapping enforces the combination of the bottom-up and top-down perspectives that the Systemic Design is approaching in this research project, considering all the spectrum of Atlantis precinct stakeholders—ensuring a proposed model of a Circular City that creates value from a systemic perspective.

6.4 Visualize & Interpret

After the data collection phase was finished, the researcher moves to the visualisation phase of the data within an inductive method, which eased the interpretation of the data complexity (Figure 3.3). This phase was executed according to the methodological steps described in section 3.8.1.3. On this visualisation made by the researcher applied the design skills and through a research synthesis, the graphic representation of the collected data, exposing their potential correlation. Allowing the reframe of Atlantis precinct wicked problems, highlighting the driving factors and sleeping assets. As a result, the infographic visualisation of the Atlantis precinct as a system mirror the complexity and wickedness of real-life networks of interconnected problems (Sevaldson, 2018).

Nevertheless, the interpretation of the database for the Atlantis precinct was challenging, given the difficulties presented on the data collection presented in Table 6.2. At that stage, the researcher had to synthesise information in order to highlight the potential visualisation to generate later connections between the categories (Urban Fabric- Demography-Economy- Culture).

Hence, this phase position the information on a common ground where all stakeholders could provide productive and collaborative feedback to the future CE strategies for Atlantis precinct. The researcher to display the information smoothly and comprehensively applied an infographic tool to elaborate visualisations. The role of the researcher (designer) was as a mediator between Atlantis precinct complex data and the stakeholders, translating the given information into an efficient and straightforward visual language through infographic maps or giga-maps.

The interpretation phase (Figure 3.3) delivered holistic construction of the Atlantis precinct, enabling in-depth analysis through establishing connections among the data presented on each infographic map. Furthermore, visualisation allowed the interpretation of the Atlantis precinct, data's flows, as well as relational factors, encouraging an overview of the existing relationships between the components and processes (Figure 3.8).

The interpretation also involved the participation of the lead stakeholders who elaborate along with the researcher a further analysis of the complex scenario, integrating all feedback. The interpretation of Atlantis precinct oversees the system's criticalities to achieve circularity beyond the immediate cause but from a broader perspective of how it can be addressed from a systemic point of view.

URBAN FABRIC

The data collection around the urban fabric category was focused on morphological features and natural resources having special attention on existing infrastructure, urban voids and public services (with a focus on quantity)(Figure 6.36). The precinct located at 45km from CoCT is contained in a peri-urban area with a total surface of 28.84 km2. Established under the concept of "the apartheid city", this precinct was divided into the following areas (Figure 6.37):

- *Industrial:* characterised to concentrate on most industrial infrastructure.(location of the Greentech SEZ)
- *Residential*: characterised by seven neighbourhoods, also concentrates most community services.
- *Informal settlements:* the Witsand area is known for high density of informal housing.
- *Commercial;* characterised for concentrate most small shops and commerce of the precinct is concentrated.

These sectors reveal the morphology of Atlantis; this can be seen on the distribution of the public space, industry, housing and public services. In particular, the precinct is cut in two by a land barrier dividing the Industrial from the rest was a characteristic of the apartheid planning. Today such characteristic has segregated the industrial area from the rest of the precinct; the access is only possible commuting by car. Therefore, this has created a lack of accessibility from the north side inhabitants to the south side, shaping perceived insecurity across the precinct.

The Atlantis precinct is surrounded by a considerable belt of green areas between nature reserves (east) and agricultural areas (west). Mainly is surrounded by 147km2 a significant extension of indigenous vegetation distinctive from the area called Atlantis Sand Fynbos (vegetation dominated by bush characterised by acidic soils and growing woody vegetation). However, such indigenous vegetation is endangered by agricultural practices which have developed irrigation techniques to cultivate in the dry Atlantis Sand Fynbos (CoCT,2018a).(Figure 6.38)(Figure 6.39)

Even though it is surrounded by indigenous nature, the inside public greenery or public parks is reduced. The urban biodiversity and local ecosystem are not connected this also due to the freeway system that surrounds the precinct: Dassenberg Drive and R304.

Also, within the naturalistic landscape, Atlantis poses at south-east 32km2 of sand dunes which have attracted a considerable amount of tourist in last years.

At levels of connectivity infrastructure, the vast spaces on highway infrastructure are a priority. As a result, this resembles the mobility components which give priority to the private vehicle. Even though the Cape Town CBD is connected with 2 MyCity BTR bus lines, there is a lack of public transport connectivity inside the precinct —creating a sense of isolation (ghetto) in the precinct due to accessibility.(Figure 6.37)

The analysis of the built environment enables to see that most of the Industrial area is currently urban voids, part of the ex-industrial areas revealing the challenges and disconnection between the services of the district and the rise of brownfields and polluted areas. On that site will be located the Greentech SEZ, not only to regenerate the area but also the entire precinct.

The morphological analysis also reveals the amount of social housing. An 80% of the residential area is composed of social housing, characterised by al low density (1-story houses) which gives the environment of a ghettoised sprawl (Figure 6.36)(Figure 6.37). Due to this sprawl effect, the communities of the outskirts of the precinct are considered almost rural housing. Even though Atlantis was conceived as Coloured Industrial Township with formal housing, the migrating Black-African population that arrived created the informal settlement of Witsand that lacks most of the essential public services. Moreover, the decline of the precinct it reflected in its real estate prices for rent and sale, which are the lowest in the City.

A highlight on the precinct metabolism is the Atlantis Water Resource Management Scheme has successfully restored and recycled water for more than three decades. A scheme that uses water treatment to processes wastewater and stormwater into large basins where it is infiltrated into a sandy aquifer from where it is abstracted and reused for local water supplies (30% of Atlantis' groundwater supply is augmented through artificial recharge) (DAW, 2010). This water recycling scheme safe the precinct from the exceptional drought that CoCT suffered in 2018, almost becoming the first metropolis to run out of water. On that view has proven to be an example of resilience within natural resources.(Figure 6.37)

On regards, household waste management was not possible to calculate as a waste collection in CoCT is executed by different private companies. In particular, the Atlantis precinct does not have any door to door recycling program. Nevertheless, the city government has a recycling facility or Atlantis Waste Drop-off in the area where citizens can drop the following waste: garden waste, glass, paper, plastics, electronic, motor oil, cans and metal, paper, cardboard, e-waste, clean builders rubble, polystyrene and tetrapak. Still, there is very little

Figure 6.36 Atlantis Holistic Diagnosis Urban Fabric Part I

Figure 6.37 Atlantis Holistic Diagnosis Urban Fabric Part II

Holistic Diagnosis
ATLANTIS

28.840.000 m²
Surface area

SCALE 0 100 200 300 400 500 600m

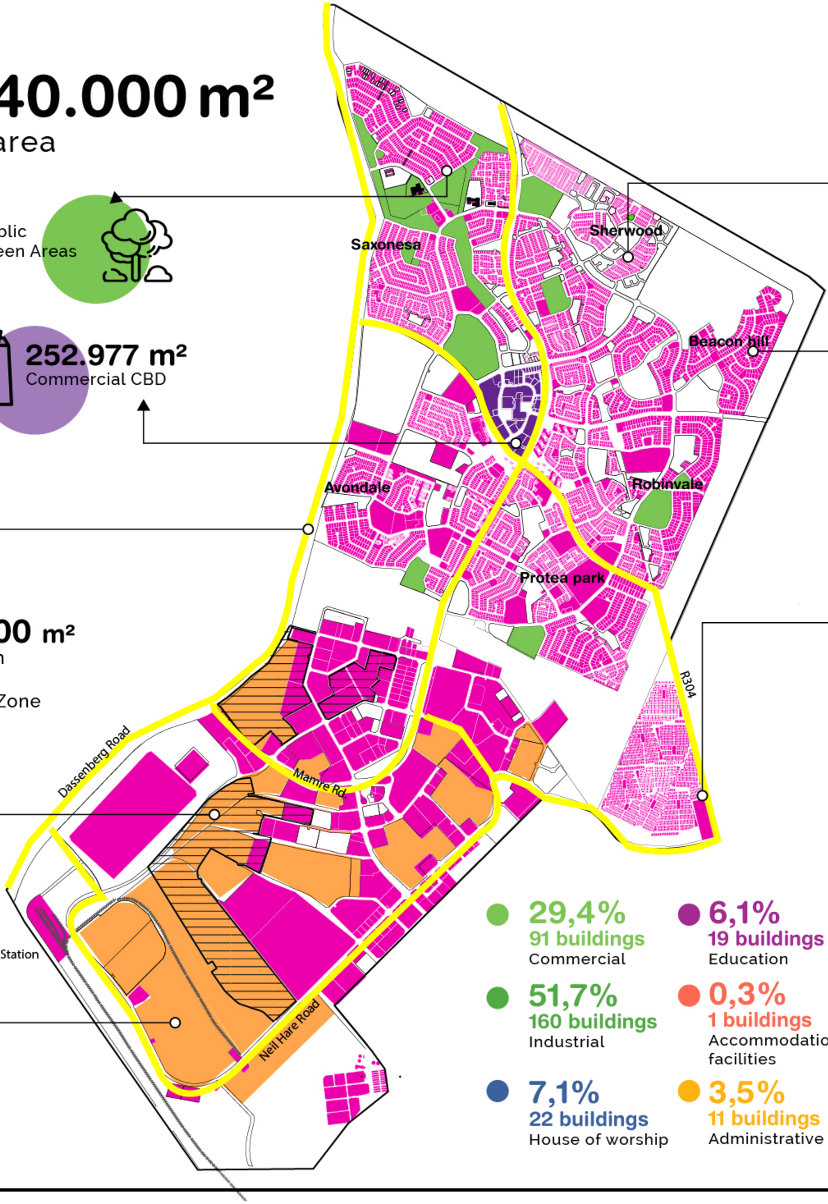
Public Green Areas

252.977 m²
Commercial CBD

31.500 m
Connectivity space
Key road links

1240000 m²
Green Tech Special Economic Zone

17
Industrial Empty sites



57%
16.405.000 m²
Built enviroment area

7.760.731 m²
Formal Housing

645.937 m²
Informal settlements

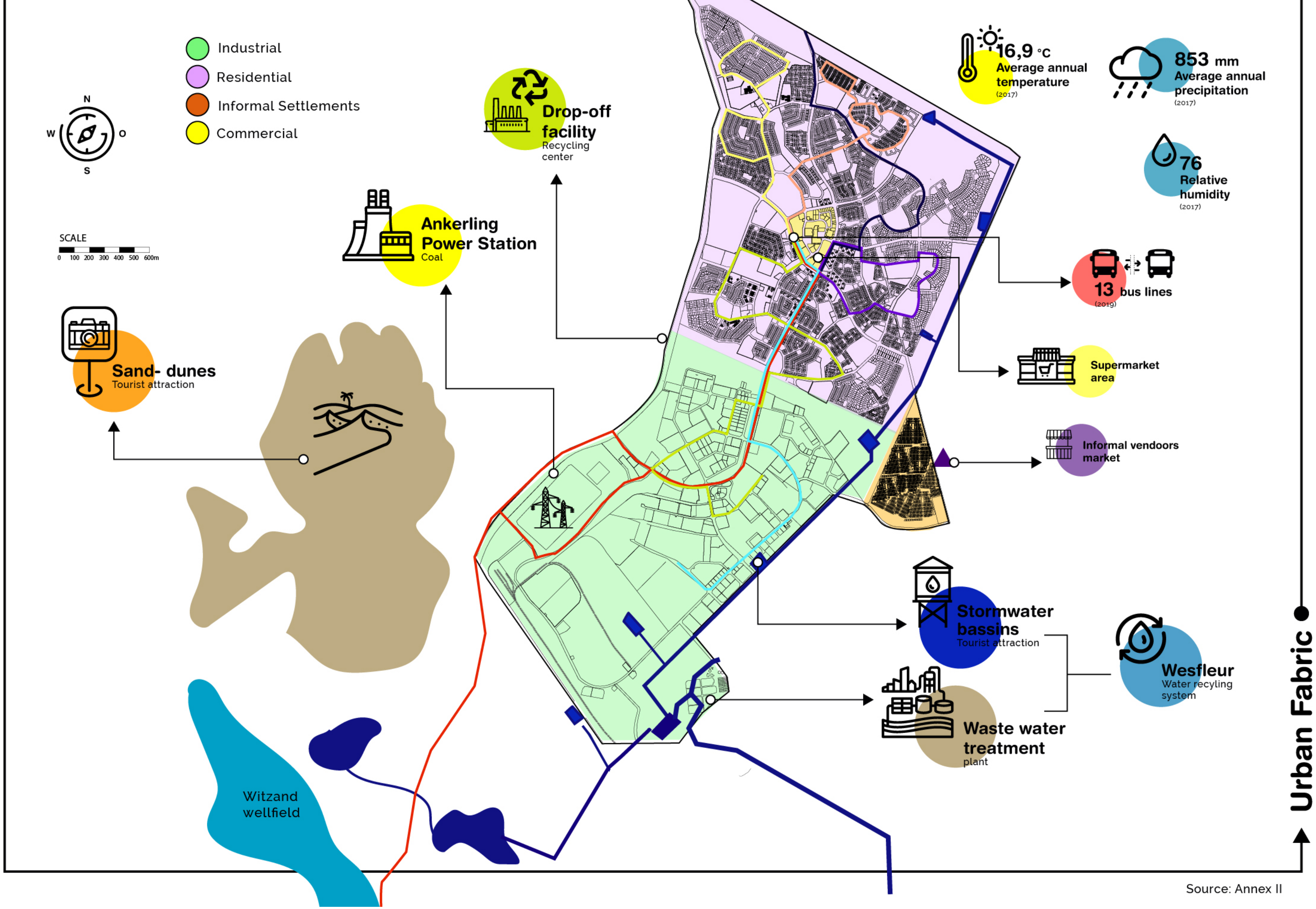
Non resisdential buildings

- **29,4%** 91 buildings Commercial
- **51,7%** 160 buildings Industrial
- **7,1%** 22 buildings House of worship
- **6,1%** 19 buildings Education
- **0,3%** 1 buildings Accommodation facilities
- **3,5%** 11 buildings Administrative
- **1,6%** 5 buildings recreational

Urban Fabric

Source: Annex II

Holistic Diagnosis
ATLANTIS



Source: Annex II

Urban Fabric

Figure 6.38 Atlantis Sand Dunes Tourist Attraction- Source WESGRO 2019

Figure 6.39 Indigenous vegetation distinctive from the area called Atlantis Sand Fynbos (vegetation dominated by bush characterised by acidic soils and growing woody vegetation - Source Author 2019

awareness on regards wastes management on the precinct as residents do not have an awareness of such facilities and assume all of their waste will go to that facility.(Figure 6.36)

On regards to food security, the precinct is a peri-urban surrounded by large and rural agricultural areas, ensuring a constant local supply of products by informal vendors and supermarkets. Over the years, there have been initiatives to promote the cropping of the local indigenous products (related Atlantis Sand Fynbos). However, there is still a vast unawareness on the local ecosystem and heritage. (Figure 6.38)(Figure 6.39)

Demography

The demography section described the state-of-the-art of Atlantis, conceived as coloured precinct as only coloured people were suited to work in the industry according to the apartheid policies (Figure 6.41)(Figure 6.42). Accurately, it presented the consequences of the apartheid policies in their population with a vast majority of coloured people, what has created a ghetto environment and sometimes discrimination towards minority races like Black-Africans. In addition to that, the economic crisis of the precinct has brought socio-economic degradation and social cohesion challenges (from poverty, hunger to unemployment).(Figure 6.40)

From the enforced migration in the 1970s from central Cape Town precincts to the industrial diaspora crisis in the 80s the transformation of the social fabric over the years, has reflected on the current population growth rate. The precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city.(Figure 6.42)

From the sociotechnical perspective, the analysis delivered radiography of the post-industrial society of Atlantis. The high unemployment rate of almost 20.481 phenomena has reflected in several aspects. Firstly, the precinct is predominantly young with an average of 30 years old this means that there are not enough job opportunities for the local population. The young population are at high risk

Figure 6.40 Atlantis community riots, demanding infrastructure upgrades July 2018 - Source SABC News 2018

of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. As a result, a progressive decline of the population density, due to the lack of opportunities most people want to leave the precinct.(Figure 6.41)

The public services and infrastructure consist of 20 facilities of public services between (libraries, theatres, community centres, police station); however, they are not enough, and the community has been rioting against CoCT government to improve public services (Figure 6.41)(Figure 6.42). Besides, there is a considerable amount of worship places due to the broad spectrum of religions present in the area from Christians, Catholics, Lutherans, Anglicans and Muslims; these are the places where the community gathers the most, this definitely can be taken as a strong asset (validation of this information during field visit). Another place key place for community is the network of 15 schools which are a crucial factor in the territory as leverage for change.

On regards, the health indicators, the rate of death by disease is mostly related to HIV/AIDS; which is related to the socio-economic degradation of the precinct. Nevertheless, the main challenge that has the community has faced in the last 30 years the high rates of alcoholism, develop amid the unemployment crisis and isolation of the precinct. As a result, the precinct has an extreme incidence of foetal alcohol syndrome (FAS) correlated with excessive alcohol consumption by mothers during pregnancy. Such syndrome has brought behavioural problems like impulsiveness and inability to concentrate – characteristics of FAS spectrum disorders (IOL, 2015).

On the field visit to the Industrial Area, the researcher could confirm that due to the high rates of alcoholism, workers are not expected to arrive on Monday mornings to work as most of them are still drunk or in a hangover. On that perspective, it is difficult for industrials to hire local people as they are unreliable.

ECONOMY

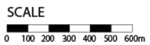
The economic indicators are evidence of how the precinct has transitioned from an apartheid precinct economic model to a steady status of socio-economic failure. The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. As a result, numerous urban voids on the precinct show a progressive depletion industrial and commercial activities. (Figure 6.43)

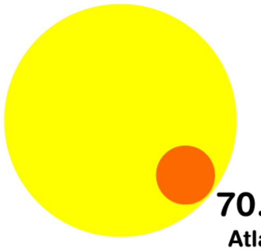
Figure 6.41 Atlantis Holistic Diagnosis Demography Part I

Figure 6.42 Atlantis Holistic Diagnosis Demography Part II

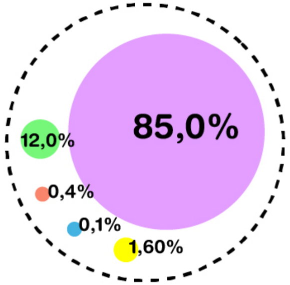
Holistic Diagnosis
ATLANTIS

Population



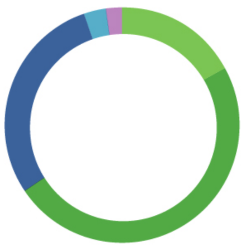


Diversity statistics
(2011).

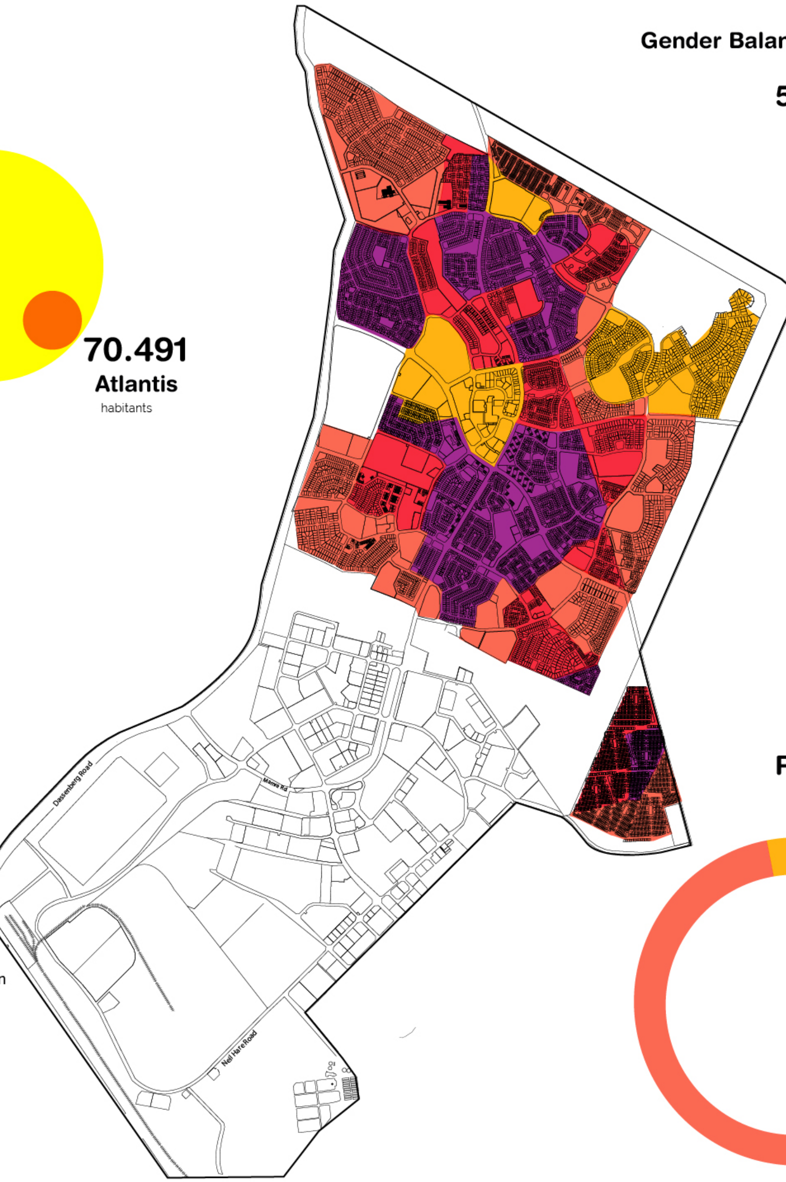


- Coloured
- Black African
- Asian-Indian
- Other
- White

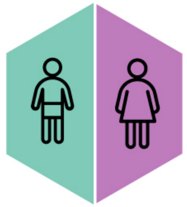
Educational level



- 17,9% Primary school
- 48,0% Secondary school
- 29,10% Matric
- 3,10% Higher Education
- 2,00% No Schooling



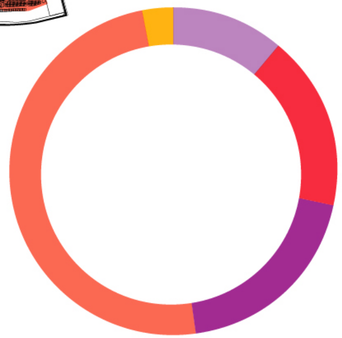
Gender Balance



Population density
(absolute value)

- 0 - 11
- 11 - 140
- 140 - 298
- 298 - 525
- 525 - 1209

Population Age ranges



- 11,1% 0 - 4 years
- 17,4% 5 - 14 years
- 19,5% 15 - 24 years
- 48,9% 25 - 64 years
- 3,0% 65 - < years

Demography

Source: Annex II

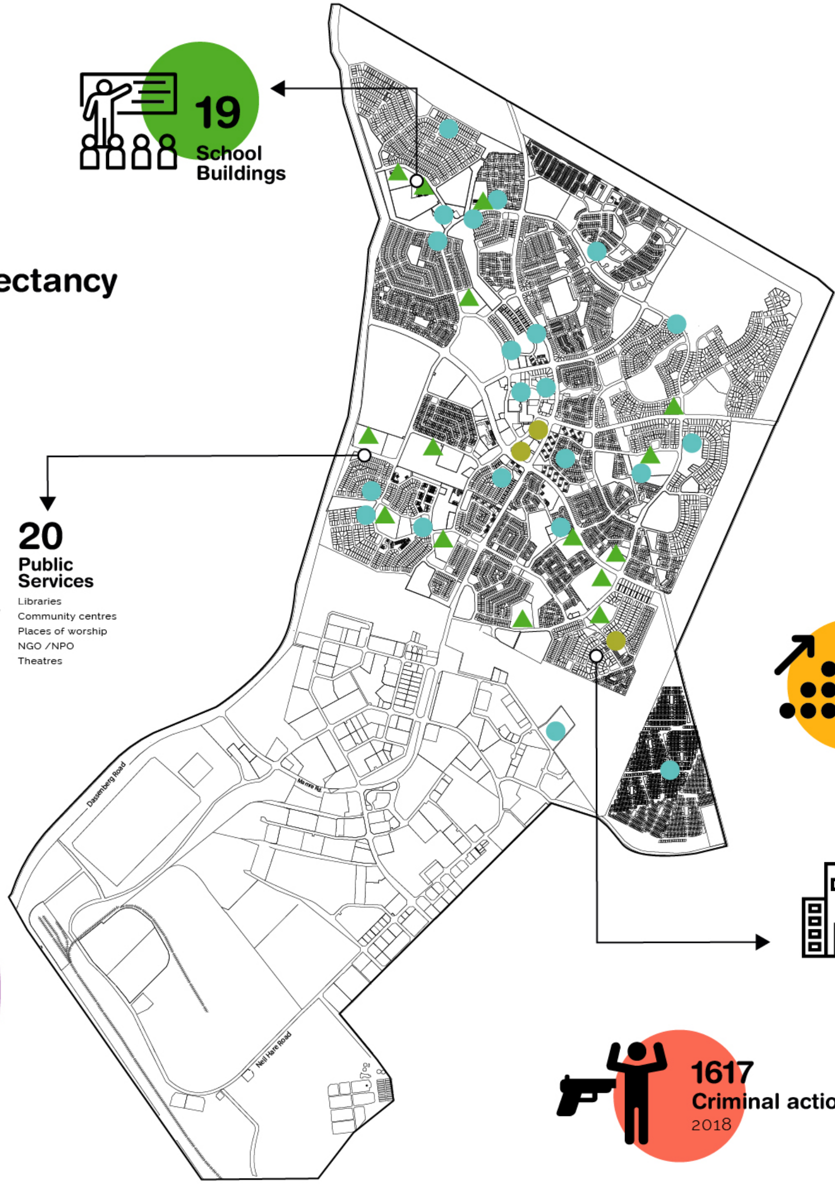
Holistic Diagnosis
ATLANTIS

N
W O
S

SCALE
0 100 200 300 400 500 600m

65 years
Life expectancy (2019)

19 School Buildings



30 years Average age of the district

20.481 Employed Population
Between 15-64 years

20 Public Services
Libraries
Community centres
Places of worship
NGO /NPO
Theatres

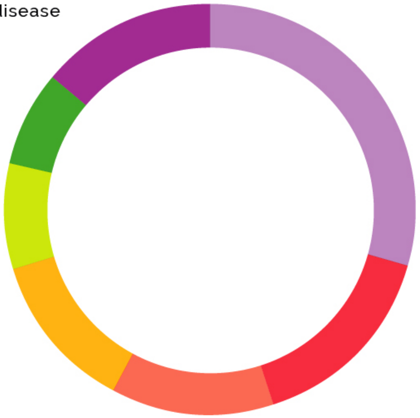
2,49% (2019) **Population grow rate**
Average annual rate of change of population size (%)

3 Public health services

1617 Criminal actions
2018

Cause of Death
Chronic Diseases

- 14.5% HIV/AIDS
- 6.1% Car Accident
- 6.8% Alcoholism
- 4.5% Respiratory infections
- 6.5% Interpersonal Violence
- 3.6% Cerebrovascular disease
- 6.3% Heart disease



Demography

Source: Annex II

The total population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics. The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development. Since the decline of the precinct, the population skills have not diversified or growth enough. This phenomenon is reflected in the fact that most workers of Atlantis come outside of the precinct, meaning that the industries can not find the required skills inside the precinct. The high rates of Unemployment on the area also influence the diaspora of young people and the scarce settling of new families into the precinct (ALTGEN, 2019)(Figure 6.44).

On relation to local commerce, by planning morphology is all concentrated on the precinct centre predominated by a shopping mall, so there are no local shops across the residential areas. However, informal traders have a significant role in the precinct they are situated in strategic areas to sale, mainly fruits and vegetables (Figure 6.34).

Today, 287 companies are present in Atlantis from which 91 are services, 75 SMMEs and 121 belong to the manufacturing sector. Particularly in the manufacture, 101 companies are SMMEs which entrepreneurial force is significant still (Figure 6.42).

On the manufacturing side, there are still 121 enterprises on the sectors Metal & Engineer, Plastics, Food-beverages, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and boat builders. The most significant is the 27 Metal & Engineer companies which are mostly large companies (i.e. Atlantis GRI Renewable Industries wind energy manufacturing or Atlantis Foundries) (Figure 6.15)(Figure 6.26)(Figure 6.43).

The industrial waste as the household waste is very challenging to monitor as every company hires its own waste collector company. Nevertheless, since 2015 the WISP team has created a material flow analysis database that regards all the manufacturing sector of Atlantis. Such database aims to create opportunities for industrial symbiosis among the companies or create new entrepreneurial activities from the current waste flows. The data provided by WISP allowed to visualised that the typologies of industrial waste have the potential for synergies in local activities or industries; some of these synergies are already happening. On that view, the Atlantis Greentech SEZ goes beyond a physical space but aims to embed the CE at all levels in the precinct. Still, as shown in the (Figure 6.44), the quantities were available, but for data protection reasons, this examination cannot publish them in this research, only will be presented the typologies.

On regards, the economic reactivation the presence of Greentech SEZ is a key actor as it aims to establish a Greentech industrial park in Atlantis. For that purpose, the CoCT provided 101 ha of land of vacant/deprived ex-industrial to promote the revitalisation of Atlantis as a strategic development node. This epicentre of Greentech enterprises will offer opportunities and incentives to national and international investors. The Atlantis SEZ is foreseen to attract almost R3.7 billion (US$262million) in investment over the next two decades. Also, the revitalisation operation would entail a re-engineering of current industry clusters and assistance for upcoming Greentech businesses (Wind turbines, solar panels, insulation, biofuels, electric vehicles, materials recycling and green building materials)(Figure 6.44).

On that view, the Greentech hub aims to encourage CE strategies within the existing manufacturing sectors to become suppliers and component manufacturers for the upcoming green industries. The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. The aims are to create an integrated circular vision of the precinct, an opportunity to enhance the local value at levels of the urban fabric, community, local economy and local heritage (GreenCape, 2020).

Figure 6.43 Atlantis Holistic Diagnosis Economy Part I

Figure 6.44 Atlantis Holistic Diagnosis Economy Part II

Figure 6.45 Atlantis Holistic Diagnosis Culture

Holistic Diagnosis
ATLANTIS

N
W O
S

SCALE
0 100 200 300 400 500 600m

287
Companies
Total
(2019)

121
Manufacture

20
Large

101
SMMEs

91
Services

75
SMMEs
(non manufacturing)

Manufacture companies
(2019)

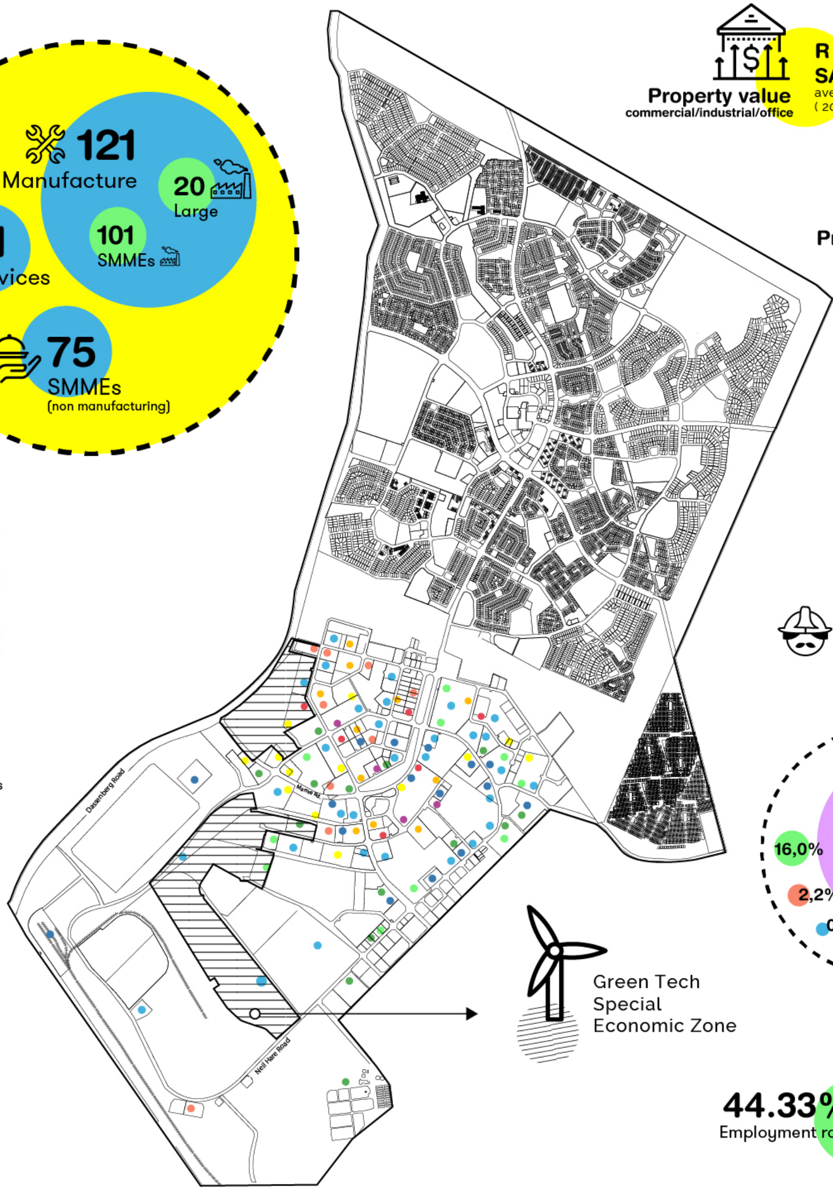
121
Companies

- 34,7% — 27 companies — Metals & Eng
- 23,5% — 19 companies — Plastics
- 21,0 % — 16 companies — Textiles
- 17,3 % — 14 companies — Chemicals
- 16,1 % — 13 companies — Construction
- 12,4 % — 10 companies — Wood
- 11,1 % — 9 companies — Food - Beverages
- 7,4 % — 6 companies — Electronics
- 4,9 % — 4 companies — Agriculture
- 4,9 % — 4 companies — Boat Builders

Locally employed versus commuters
(2019)

72%
Employed
Outside of Atlantis

28%
Locally Employed



Green Tech
Special
Economic Zone

Real estate

Property value
commercial/industrial/office
R 200.000 R/m²
SALES
average price 1000m² (R/sqm)
(2019)

Property value
residential use
R2.000 – R2.500
SALES
average price (R/sqm)
(2019)

3500 ZAR
148 € aprox
Monthly
Revenues
by household

27.897
Labour force

81,0%
16,0%
2,2%
0,4%
0,1%

- Coloured — 22,641 people
- Black African — 4,467 people
- Asian-Indian — 120 people
- Other — 618 people
- White — 51 people

44.33%
Employment rate

26.58%
Unemployment rate

Economy

Systemic Design for Circular Cities

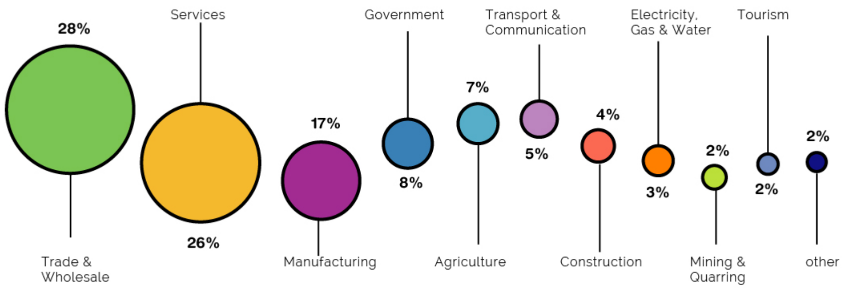
Source: Annex II

Holistic Diagnosis
ATLANTIS

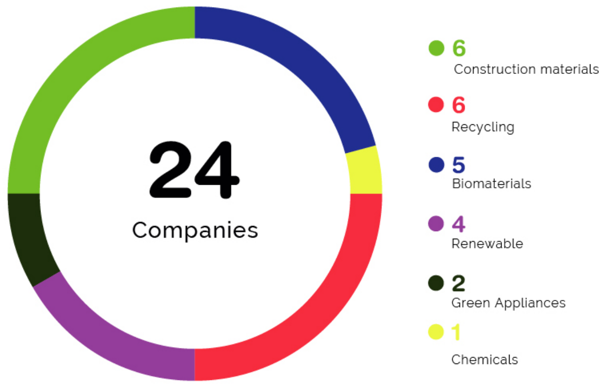
Material-flow manufacture sector
(2019)

Sector	inputs	output
Metals & Eng	Stainless steel Cast iron handles Electrical Components Nylon moulded handles Aluminium Pallets Polish Adhesives Wood / Plastic palets	metal filings, chips and powders material absorbents, filter materials Packaging/plastics/ paper Sludge Wood / Plastic pallets
Plastics	Polymers Thermoshape Resines Epoxy Silicones elastomers Polyurethane	Resines chips /powders Packaging of raw material
Construction	mineral sand, stones clay, cement, bricks, tiles and ceramics Wood Wood Pallets	mixtures of cement, bricks, tiles and ceramics, Pallets Packaging
Food	Legumes /Cereal Flours /Fish /Beef Oils/Wheat Oats/Sugar/cans Plastic packaging Pallets wood	Organic waste seed and peels Pallets woods Chemicals sludge paper off-cuts metals off-cuts cardboard Plastic packaging
Agriculture	Seeds Fertilizers Pallets wood Packaging plastic Soaps	Organic Waste Wood Pallets Packaging
Boat Builders	Glass fibre woven Polyester resin Plastic Hyperlon Marine plywood Gelcoat Stainless steel pipes Plastic Packaging Acetone Polish	Fibreglass (GRP) off-cuts Hyperlon sheet off-cuts Marine ply off-cuts Acetone sludge
Textiles	Acrylic yarn Pigments Polyester fabric Tannins parafin Oils microfiber fabric Polyester Dacrons PVC bags Fibre Glass Polycotton	Leather Pigments Wood Tanins Fabrics /thread
Electronics	Steel Electrical Components Aluminium Pallets Polish Adhesives Wood / Plastic palets	metal filings, chips and powders Cable / electronic material absorbents, filter materials Packaging/plastic s/paper Wood / Plastic palets
Chemicals	Acetones Resin Gelcoat Adhesives Soaps Pigments	Dirty water
Wood	Wood / steel / aluminium Pigments Pallets Wood Plastic Packaging Wood wax/polish/ sand paper/ Timber	chipping wood ash Wood pallets varnish packaging

Job occupations
(2019)



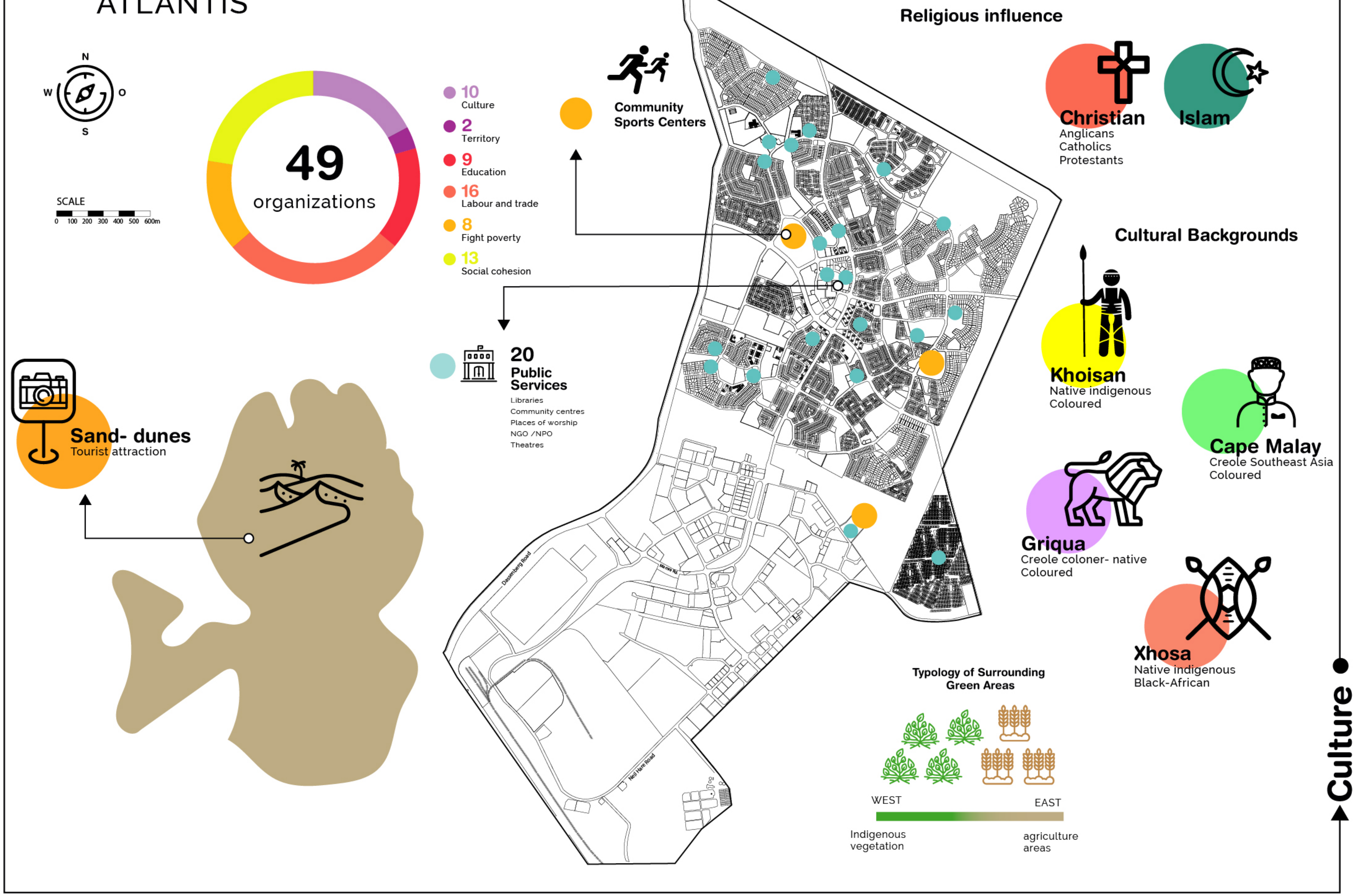
Green Companies
(2019)



Economy

Source: Annex II

Holistic Diagnosis
ATLANTIS



Source: Annex II

CULTURE

Given the historical background of this precinct, the cultural identity of the precinct has struggled since Atlantis foundation. The precinct's history represents the cultural influence of apartheid policies shaped all aspects from the urban fabric to demographic and economic (Figure 6.45).

The coloured people community that moved into the area has different cultural backgrounds such as:

- *Griqua*: 19th-century people of mixed Khoekhoe and European lineage, who occupied the region of central South Africa.
- *Khoisan:* are a blend of the Khoi and San indigenous people of Southern Africa. The Khoi people originated from the coastline of the country and the San from the northern areas, especially in the Kalahari region.
- *Cape Malay*: or Cape Muslims are an ethnic group or community in South Africa. They came initially were brought as slaves or exiles from the Dutch East Indies from India to Eastern Indonesia.

Later on, other Black-African communities moved with a Xhosa cultural background. Nevertheless, the morphology of the precinct and the apartheid government policies never allow space where this cultural heritage flourish. Such suppression led to an identity loss on the precinct where the majority of the inhabitants do not know their cultural heritage.
Today the neighbourhood does not have any heritage infrastructure, museum or monument. Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community.

To overcome the phenomena, the current cultural agenda has been promoted by a strong influence of the Third sector actors over 49 organizations working on the precinct—especially the associations: Atlantis First Indigenous peoples community, Khoisan renaissance cultural awareness and Griqua Royal house. These organizations are promoting the conservation of the cultural heritage and new urban identities to arouse on one side reflection and sense of belonging by the inhabitants; on the other hand, interest, and attraction for the Atlantis territory (Figure 6.45).

The cultural identity of the precinct relies upon the community centres, different centres of worship (churches and mosques). Nevertheless, the fact of being in a peri-urban area surrounded by indigenous vegetation on the one side and the other extension of the agricultural area has influenced by traditional agricultural practices. Several organisations have promoted such practices such as Atlantis Small Farm Association and Orion Organisation (promotes community greenery).

This information mostly came from informal conversations on-site visits to representatives of Atlantis First Indigenous peoples community, Khoisan renaissance cultural awareness and Griqua Royal house (Figure 6.35).

6.5 Definition of problems & leverages

As previously explained in section 4.7.1 to reach a Circular City model, it is necessary to overview the local assets of Atlantis precinct critically, in order to target the local assets that could serve as potential levers and activate a systemic transition towards circularity and value creation. For this framework on post-industrial precincts, was defined two criteria of assessment of Local Assets Potential Levers; Opportunity as value creation and Challenge as value creation.

This stage addressed every local lever of Atlantis in order to support a system transition towards a Circular City model. Furthermore, this stage also has in consideration (Table 6.3) analysis of the Policy Framework Analysis, where it identified the current levers policies & projects that could support future CE strategies on a Circular City model.

The Table 6.5 is part of the research synthesis of the previous visualization phase, it presented a critical overview of the local assets in order to target the local assets that could serve as potential levers for

Table 6.5 Atlantis precinct analysis of Local Assets Potential Levers

	OPPORTUNITY AS VALUE CREATION	CHALLENGE AS VALUE CREATION
urban fabric	-East side surrounded by indigenous vegetation Atlantis Sand Fynbos. -Westside surrounded by Agricultural area. -Sand dunes areas extended to the west with good ecological potential. (current tourist attraction) -Rural agriculture present on the precinct outskirts -Majority of Social Housing / formal housing. (houses one-story structure) -Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant. -Atlantis is infested with large swaths of alien tree species (Gum, Pine, and especially Port Jackson). -A high number of public spaces / civic commons. -A high percentage of industrial infrastructure. -Presence of Atlantis Waste Drop-off for recycle. Potential for new economic/ social purposes.	-Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planning legacy) -Lack of accessibility of public space areas from the industrial area -Insecurity perceived in the in the public space and industrial area -Commuting limitations,- Isolated precinct due to accessibility - (is not an area attractive to visitors) -Large connectivity spaces for highways (voids). -Lack of density on the built environment. Sprawl precinct, lack of cohesion and low walkability index. -Informal settlements WITSAND- lack of services, unstable infrastructure -The area does not offer an extended offer on leisure and recreation/culture (segregation factor) -Presence of 17 post-industrial areas underutilized (urban voids and brownfields) -Some buildings of the area in need of significant refurbishment and have been built with materials like Asbestos. -Waste household managed by private operators, direct to dump site on a ratio 50km. (scarce recycling practices). -Industrial waste not properly managed -Most energy is sourced by Plant generator coal
demography	-Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.) -A strong presence of the Third sector and social cohesion initiatives. -The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years -Predominantly coloured race population.	-Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: Black-Africans. -Lack of job opportunities for the local population, -Lack of connection between the industry and the local community. -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Population exodus from the area (lack of opportunities young /segregation factor). Leaving space for gangsterism. -Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Biggest employer manufacture sector -A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables. -24 Circular Business; Biomaterials 5, chemicals 1, Construction materials 6, Renewable energy, 4, green appliances 2, recycling 6 . -Lowest prices of real estate on the City -Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food-beverages, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and boat builders. -The most significant sector is the 27 Metal & Engineer companies which are mostly large (i.e. Atlantis GRI Renewable Industries wind energy manufacturing - Atlantis Foundries - Hisense, Chinese electronics manufacture). -The total population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics. -The Greentech hub aims to encourage CE strategies within the existing manufacturing sectors to become suppliers and component manufacturers for the upcoming green industries. -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network.	-Socio-economic degradation (Economic crisis of the area has brought unemployment -Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct. -Industrial waste not connected to local business activities -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development. -Since the decline of the precinct, the population skills have not diversified or growth enough. -Workers of Atlantis come outside of the precinct, meaning that the industries can not find the required skills inside the precinct. -The shops and commerce of the district are concentrated on the precinct centre predominated by a shopping mall, so there are no local shops across the residential areas. -The industrial waste as the household waste is very challenging to monitor as every company hires its own waste collector company.
culture	-Strong network on active community involvement programmed. -Besides, there is a considerable amount of worship places due to the broad spectrum of religions present in the area from Christians, Catholics, Lutherans, Anglicans and Muslims; -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. -Minority Black-African communities with a Xhosa cultural background. -Traditional agricultural practices. -The cultural identity of the precinct relies upon the community centres, different centres of worship (churches and mosques). -Organizations are promoting the conservation of the cultural heritage and new urban identities to arouse on one side reflection and sense of belonging by the inhabitants; on the other hand, interest, and attraction for the Atlantis territory	-Lack of awareness on the historical heritage or indigenous cultures. -On overcoming the cultural legacy of apartheid, the community of Atlantis was labelled under the coloured race label. -Neglecting the existence of diverse cultural groups. -Lack of heritage infrastructure, museum or monument. -Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area. -The precinct's history represents the cultural influence of apartheid policies shaped all aspects from the urban fabric to demographic and economic.

circularity. Moreover, it highlights the holistic challenges issues in Atlantis precinct that hamper circularity but could represent an opportunity (challenges into opportunities). At the same time also creates awareness in opportunities that foster a Circular City model inside the precinct. So, as a result, there is a shared understanding of the current levers presents on Atlantis that could support future CE strategies on a Circular City model.

6.6 Design the system & Circular City model

After achieving the synthesis of all local asset levers of the Atlantis precinct, in this stage, the researcher addressed the outcomes of Table 6.5 and Table g6.3 (Policy Framework analysis) through a co-design approach assessment to identify and co-create of the circular city actions proposed in (Figure 4.5) (see section 4.7.1) with the local stakeholders.

As optimization and localize actions are mandatory prerequisites for all Circular Actions to happen (Figure 4.5), the framework was approached identifying the Main Circular Actions and subsequently, the supporting actions. According to this, the Co-Design Session Round table intended to identify the Mirafiori South precinct levers that can support the Main Circular Actions (looping, regenerating and adapting) in Atlantis precinct.

CO-DESIGN SESSION ROUNDTABLE

As described in section (4.7.1), the roundtable discussion involved a group of the identified the "lead stakeholders" (Table 6.4) such as; City of Cape Town Spatial Planning and Environment Directorate (government), Wesgro (industries), Atlantis SEZ Community Stakeholder Network (communities) and the GreenCape (research institutions) (see Table 6.4). Other attendants (i.e. Atlantis Economic Development Agency (Business SMME), South African Renewable Energy Incubator (SAREBI), Atlantis Business Chamber (Business SMME) Atlantis Industrial Initiative (Business IndustryLuphulo Atlantis Business Development Forum (Business Informal & Cooperatives) and Atlantis Investment Facilitation Office). The objective was to bridge connecting the Local Assets /Potential Levers (HD maps - Figure 6.36-37-41-42-43-44-45) of the precinct and the Main Circular Actions, following a quadruple helix dynamic.

The roundtable session was carried as an engaging event,' (Meroni et al., 2013), stakeholders were invited by the City of Capetown and the GreenCape to the session conducted at a community centre located in Atlantis precinct, on 23rd July 2019. (Figure 5.46)

The objective of this gathering was to display the outcomes of the Local Assets /Potential Levers (Table 6.5)(HD maps - Figure 6.36-37-41-42-43-44-45) and co-design the classification of the assets that can

Figure 5.46 Round table session Atlantis Stakeholders I

sustain the Main Circular Actions and subsequently the supporting actions. The following steps and tools where executed :

1. *Set up :* Registration process and setting up the roundtable.
2. *Introduction:* Introduce the findings of the study (HD maps - Figure 6.36-37-41-42-43-44-45, Local Assets /Potential Levers, Main Circular Actions.
3. *Circular Actions Co-Design:* The participants provided further feedback on the presented HD maps, Local Assets /Potential Levers. Such feedback was vital due to the scarce written material on the precinct. Later, the stakeholders altogether were asked to outline which identified Local Assets / Potential Levers could support the Main 3 Circular actions (Loop/ Regenerate/ Adapt) in order to facilitate implementation on Atlantis. Some of the participants proposed future circular scenarios captured in (Figure 6.47-28)
4. *Final Discussion:* The discussion was open to the audience, to welcome additional feedback and enrich the framework.

In the context of Atlantis precinct, organizing such meetings can be challenging as the participants of the community tend to be sceptical, as explained in the introduction participatory process have been criticized over the years. On that view, this discussion was not only designed to provoke the stakeholders to identify assets in each circular action but also meant to serve the participants think the assets of the Atlantis Precinct holistically, from a local culture point view. In order to determine circular actions that create value and are resilient over time. Therefore, the roundtable discussion enabled sharing needs and offerings (in order to optimize the use of the local assets and levers) as well as an opportunity for building future collaborations on circular strategies. On that matter, it intended to bridge as well the circular opportunities that the GreenTech SEZ will bring and the community assets. During the roundtable discussion, the researcher also meant to make straightforward her role and responsible practice, based on open communication with the stakeholders.

The discussion was documented via photo, and the data obtained at the gathering is displayed in Table 6.6, which addresses the Local Assets/ Potential Levers supporting Main Circular Actions and Table 6.7. represents the Policy Framework supporting Main Circular Actions.

The results of this examination presented a re-desing system based on the conceptualization of a Systemic approach on Circular City framework, targeting the precinct levers (challenges and opportunities) by single or several Circular Actions. This critical approach intended to reframe Atlantis local levers in relation to the Circular City framework, in order to corroborate and enrich the framework and identify recommendations for further enquiry.

Figure 6.47 Raw data drawing , Atlantis as circular / innovation district

Figure 6.48 Round table session Atlantis Stakeholders II

Table 6.6. Atlantis precinct analysis; Local Assets Potential Levers supporting Main Circular Actions R:Regenerate A:Adapt L:Loop

	OPPORTUNITY AS VALUE CREATION	R	A	L	CHALLENGE AS VALUE CREATION	R	A	L
urban fabric	Eastside surrounded by indigenous vegetation Atlantis Sand Fynbos.	x		x	Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planing legacy)	x	x	
	Westside surrounded by Agricultural area.	x		x	Lack of accessibility of public space areas from the industrial area	x	x	
	Sand dunes areas extended to the west with good ecological potential. (current tourist attraction)	x			Insecurity perceived in the in the public space and industrial area	x	x	
	Rural agriculture present on the precinct outskirts	x		x	Commuting limitations,- Isolated precinct due to accessibility - (is not an area attractive to visitors)		x	
	Majority of Social Housing / formal housing. (houses one-story structure)		x		Large connectivity spaces for highways (voids).	x	x	
	Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant.	x		x	Lack of density on the built environment. Sprawl precinct, lack of cohesion and low walkability index.	x	x	
	Atlantis is infested with large swaths of alien tree species (Gum, Pine, and especially Port Jackson).	x			Informal settlements WITSAND- lack of services, unstable infrastructure	x	x	x
	A high number of public spaces / civic commons.	x	x		The area does not offer an extended offer on leisure and recreation/culture (segregation factor)	x	x	
	A high percentage of industrial infrastructure.	x	x	x	Presence of 17 post-industrial areas underutilized (urban voids and brownfields)	x	x	x
	Presence of Atlantis Waste Drop-off for recycle. Potential for new economic/social purposes.			x	Some buildings of the area in need of significant refurbishment and have been built with materials like Asbestos.		x	
					Waste household managed by private operators, direct to dump site on a ratio 50km. (scarce recycling practices).			x
					Industrial waste not properly managed			x
					Most energy is sourced by Plant generator coal		x	x
demography	Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.)	x		x	Low interaction between the industry/local community.	x	x	
	A strong presence of the Third sector and social cohesion initiatives.	x		x	Socio-economic degradation (Economic crisis of the area has brought Unemployment).	x	x	x
	The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station)	x	x	x	Social Cohesion challenges with vulnerable population: Black-Africans.	x		x
	Predominantly young with an average of 30 years	x		x	Lack of connection between the industry and the local community.	x	x	
	Predominantly coloured race population.	x	x	x	Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city.	x	x	x
					Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty.	x	x	x
					Population exodus from the area (lack of opportunities young /segregation factor). Leaving space for gangsterism.	x	x	x
					Post-apartheid Socio-economic degradation. Periurban precinct scarce growing of new generations.	x	x	x
					Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.	x	x	x

	OPPORTUNITY AS VALUE CREATION	R	A	L	CHALLENGE AS VALUE CREATION	R	A	L
economy	Green Tech Special Economic Zone (SEZ) - First green technology hub of Africa. for reindustrialization/ regeneration / new companies/ investment	x	x	x	Socio-economic degradation (Economic crisis of the area has brought unemployment	x	x	x
	Biggest employer manufacture sector			x	Unemployment on the area also influences the diaspora of young people and the scarce settling of new families into the precinct.	x	x	
	A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables.	x	x	x	Industrial waste not connected to local business activities			x
	24 Circular Business; Biomaterials 5, chemicals 1 , Construction materials 6, Renewable energy, 4, green appliances 2, recycling 6 .			x	The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value.		x	x
	Lowest prices of real estate on the City		x		The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development.	x	x	x
	Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food-beverages, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and boat builders.			x	Since the decline of the precinct, the population skills have not diversified or growth enough.		x	x
	The most significant sector is the 27 Metal & Engineer companies which are mostly large (i.e. Atlantis GRI Renewable Industries wind energy manufacturing - Atlantis Foundries - Hisense, Chinese electronics manufacture).			x	Workers of Atlantis come outside of the precinct, meaning that the industries can not find the required skills inside the precinct.	x	x	x
	Population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics.	x		x	The shops and commerce of the district are concentrated on the precinct centre predominated by a shopping mall, so there are no local shops across the residential areas.		x	x
	the Greentech hub aims to encourage CE strategies within the existing manufacturing sectors to become suppliers and component manufacturers for the upcoming green industries.			x	The industrial waste as the household waste is very challenging to monitor as every company hires its own waste collector company.			x
	The interaction between the GreenTech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network.	x	x	x				
culture	Strong network on active community involvement programmes.	X		X	Lack of awareness on the historical heritage or indigenous cultures.	X	X	X
	Considerable amount of worship places due to the broad spectrum of religions present in the area from Christians, Catholics, Lutherans, Anglicans and Muslims;		X		On overcoming the cultural legacy of apartheid, the community of Atlantis was labelled under the coloured race label.		X	
	Rebuild the cultural identity factor as a tool for social cohesion.	X	X	X	Neglecting the existence of diverse cultural groups.	X	X	
	Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons /	X	X	X	Lack of heritage infrastructure, museum or monument.		X	
	The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging.	X	X	X	Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community.	X	X	
	Minority Black-African communities with a Xhosa cultural background.	X	X	X	Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.	X	X	X
	Traditional agricultural practices.	X		X	The precinct's history represents the cultural influence of apartheid policies shaped all aspects from the urban fabric to demographic and economic.		X	
	The cultural identity of the precinct relies upon the community centres.		X					
	Organizations are promoting the conservation of the cultural heritage and new urban identities to arouse on one side reflection and sense of belonging by the inhabitants; on the other hand, interest, and attraction for the Atlantis territory	X	X	X				

	TOP-DOWN	R	A	L	BOTTOM-UP	R	A	L
urban fabric	CoCT Municipal Spatial Development Framework (2018)	x	x		Atlantis Small Farm Association	x		x
urban fabric	Integrated Resource Plan (Department of Energy, 2011);		x	x				
urban fabric	National Strategy for Sustainable Development (Department of Environmental Affairs, 2011);	x	x	x				
urban fabric	National Climate Change Response (2011)	x	x	x				
urban fabric	CoCT Resilience strategy (2019)	x	x	x				
urban fabric	CoCT Urban Settlement Development Grant Funds	x	x					
urban fabric	Atlantis Community Rural Development Programme	x	x					
demography	CoCT Social Development Strategy	x	x	x	Atlantis SEZ Community Stakeholder Network:	x	x	x
demography	Atlantis Skills development program	x		x	Ikamava Youth Project	x		x
demography	Atlantis Community Police Forum	x			Atlantis Alive Youth for Christ	x		x
demography					Faith Soup - Kitchen Project	x		x
demography					G-Force Arts and Culture Programme	x		x
demography					Orion Organisation	x	x	
demography					United Sanctuary social cohesion association, From Scars to Stars youth association, Child Welfare Mamre, Atlantis Family Focus:	x		
demography					DreamTeam Committee	x	x	x
demography					Concerned Citizens of Atlantis,- Mamre Council of Stakeholders - Atlantis Council of stakeholders- Witsand consent residents: Residents associations groups	x		x
economy	GreenTech SEZ Atlantis	x	x	x	Atlantis Economic Development Trust		x	x
economy	Ten Year Innovation Plan, 2008 – 2018 (South Africa Department of Science & Technology)			x	Saxon Sea Community Developments Project	x		x
economy	Atlantis Investment Facilitation programme	x		x	Hartebeeskraal Multi-Purpose Community Center:		x	x
economy	Black Economic Empowerment Model		x	x	Atlantis Unrestricted Workers Association - Atlantis Informal Traders: associations to support informal workers.	x		x
economy	CoCt Atlantis Investment Facilitation Office	x	x	x				
economy	Atlantis Business Chamber			x				
economy	Atlantis Unions			x				
economy	South African Renewable Energy Incubator (SAREBI)		x	x				
economy	Western Cape Industrial Symbiosis Programme (WISP)	x		x				
culture					Griqua Royal house	x	x	x
culture					Khoi-san renaissance cultural awareness	x	x	x
culture					Atlantis First Indigenous peoples community	x	x	x
culture					Faith Tabernacle Ministries - Witsand Ministers Fraternal	x		

Table 6.7 Atlantis precinct analysis Policy Framework supporting Main Circular Actions R:Regenerate A:Adapt L:Loop

6.7 Outcomes Evaluation

The roundtable discussion inspired further opportunities to emerge on what policies and assets of the Atlantis precinct can be levers to activate strategies towards a Circular City model. Considering these outcomes, this part of the examination intended to identify concrete CE strategies inside the Atlantis precinct (Figure 4.6). For each action was established the type of potential/ executed strategies and described in separate tables:

- *Regenerate:* green walls (Table 6.8), urban farming (Table 6.9), pollinator biodiversity (Table 6.10), water recycling (Table 6.11)

- *Adapt:* reuse infrastructure (Table 6.12), retrofitting infrastructure (Table 6.13), flexible infrastructure/community (Table 6.14)

- *Loop:* recycle (Table 6.15), reuse (Table 6.16), energy recover (Table 6.17).

The tables refined the main Circular Actions into targeted strategies for value creation in Atlantis precinct. The purpose of this examination was to understand what actions more local levers could have involved to be activated in order to propose the following implementation stage. On that perspective, it will deliver an overview of what actions could activate al Circular City model dynamic in Atlantis precinct.

REGENERATE STRATEGY - GREEN WALLS		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -National Strategy for Sustainable Development (Department of Environmental Affairs, 2011) -National Climate Change Response (2011) -CoCT Resilience strategy (2019) -Atlantis Community Rural Development Programme -Atlantis Small Farm Association: Community association develops a program for rural farming Town.	-East side surrounded by indigenous vegetation Atlantis Sand Fynbos. -Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant. -Atlantis is infested with large swaths of alien tree species (Gum, Pine, and especially Port Jackson). -A high number of public spaces / civic commons. -A high percentage of industrial infrastructure. -Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planning legacy) -Lack of accessibility of public space areas from the industrial area -Insecurity perceived in the in the public space and industrial area -Large connectivity spaces for highways (voids). -Lack of density on the built environment. Sprawl precinct, lack of cohesion and low walkability index. -Informal settlements WITSAND- lack of services, unstable infrastructure -The area does not offer an extended offer on leisure and recreation/ culture (segregation factor) -Presence of 17 post-industrial areas underutilized (urban voids and brownfields)
demography	-CoCT Social Development Strategy -Atlantis Skills development program -Atlantis Community Police Forum -Atlantis SEZ Community Stakeholder Network -Ikamava Youth -Atlantis Alive Youth for Christ -G-Force Arts and Culture Programme -Orion Organisation -United Sanctuary social cohesion association, From Scars to Stars youth association, Child Welfare Mamre, Atlantis Family Focus -DreamTeam Committee Concerned Citizens of Atlantis,- Mamre Council of Stakeholders -Atlantis Council of stakeholders-Witsand consent residents -Saxon Sea Community Developments Project: -Atlantis Unrestricted Workers Association - Atlantis Informal Traders	-Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.) -A strong presence of the Third sector and social cohesion initiatives. The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years Predominantly coloured race population. -Low interaction between the industry/local community. Socio-economic degradation (Economic crisis of the area has brought Unemployment). Social Cohesion challenges with vulnerable population: Black-Africans. -Lack of connection between the industry and the local community. Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Population exodus from the area (lack of opportunities young / segregation factor). Leaving space for gangsterism. -Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.

Table 6.8. Levers Assessment, Regenerate strategy Green walls Atlantis precinct

REGENERATE STRATEGY - GREEN WALLS		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
economy	-Greentech SEZ Atlantis	-A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables. -Population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics. -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -Workers of Atlantis come outside of the precinct, meaning that the industries cannot find the required skills inside the precinct. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development.
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community -Faith Tabernacle Ministries - Witsand Ministers Fraternal	-Strong network on active community involvement programmed. -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape -Malay, a growing sense of belonging. -Minority Black-African communities with a Xhosa cultural background. -Lack of awareness on the historical heritage or indigenous cultures. -Neglecting the existence of diverse cultural groups. -Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community.

REGENERATE STRATEGY – COMMUNITY FARMING		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -National Strategy for Sustainable Development (Department of Environmental Affairs, 2011) -CoCT Resilience strategy (2019) -CoCT Urban Settlement Development Grant Funds: -Atlantis Community Rural Development Programme: -Atlantis Small Farm Association: Community association develops a program for rural farming	-East side surrounded by indigenous vegetation Atlantis Sand Fynbos. -Westside surrounded by Agricultural area. -Sand dunes areas extended to the west with good ecological potential. (current tourist attraction) -Rural agriculture present on the precinct outskirts -Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant. -A high number of public spaces / civic commons. -Lack of accessibility of public space areas from the industrial area -Insecurity perceived in the in the public space and industrial area -Informal settlements WITSAND- lack of services, unstable infrastructure -The area does not offer an extended offer on leisure and recreation/culture (segregation factor)
demography	-CoCT Social Development Strategy -Atlantis Skills development program -Atlantis Community Police Forum -Atlantis SEZ Community Stakeholder Network -Ikamava Youth -Atlantis Alive Youth for Christ -Faith Soup - Kitchen -G-Force Arts and Culture Programme -Orion Organisation -United Sanctuary social cohesion association, From Scars to Stars youth association, Child Welfare Mamre, Atlantis Family Focus -DreamTeam Committee -Concerned Citizens of Atlantis,- Mamre Council of Stakeholders - Atlantis Council of stakeholders- Witsand consent residents -Saxon Sea Community Developments Project -Atlantis Unrestricted Workers Association - Atlantis Informal Traders	-A strong presence of the Third sector and social cohesion initiatives. -The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years -Predominantly coloured race population. -Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: Black-Africans. -Lack of connection between the industry and the local community. -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Greentech SEZ Atlantis -Atlantis Unrestricted Workers Association - Atlantis Informal Traders	-A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables. -Population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics. -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development.
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Strong network on active community involvement programmed. Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. Minority Black-African communities with a Xhosa cultural background. -Lack of awareness on the historical heritage or indigenous cultures. -Neglecting the existence of diverse cultural groups.

Table 6.9 Levers Assessment, Regenerate strategy Community farming Atlantis precinct

Table 6.10 Levers Assessment , Regenerate strategy Pollinator Biodiversity Atlantis precinct

REGENERATE STRATEGY – POLLINATOR BIODIVERSITY		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -National Strategy for Sustainable Development (Department of Environmental Affairs, 2011) -National Climate Change Response (2011) -CoCT Resilience strategy (2019) -Atlantis Small Farm Association	-East side surrounded by indigenous vegetation Atlantis Sand Fynbos. -Westside surrounded by Agricultural area. -Sand dunes areas extended to the west with good ecological potential. (current tourist attraction) -Rural agriculture present on the precinct outskirts -Atlantis is infested with large swaths of alien tree species (Gum, Pine, and especially Port Jackson). -A high number of public spaces / civic commons. -Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planning legacy) -Lack of accessibility of public space areas from the industrial area Insecurity perceived in the in the public space and industrial area -Lack of density on the built environment. Sprawl precinct, lack of cohesion and low walkability index. -The area does not offer an extended offer on leisure and recreation/culture (segregation factor)
demography	-CoCT Social Development Strategy -Atlantis Skills development program -Atlantis Community Police Forum -Atlantis SEZ Community Stakeholder Network -Ikamava Youth -Atlantis Alive Youth for Christ -Faith Soup - Kitchen -G-Force Arts and Culture Programme -Orion Organisation -United Sanctuary social cohesion association, From Scars to Stars youth association, Child Welfare Mamre, Atlantis Family Focus -DreamTeam Committee -Concerned Citizens of Atlantis,- Mamre Council of Stakeholders - Atlantis Council of stakeholders -Witsand consent residents -Saxon Sea Community Developments Project -Atlantis Unrestricted Workers Association - Atlantis Informal Traders	-Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.) -A strong presence of the Third sector and social cohesion initiatives. The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years -Predominantly coloured race population. -Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: Black-Africans. -Lack of connection between the industry and the local community. -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. -The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area. -Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations.
economy	-Greentech SEZ Atlantis -Atlantis Unrestricted Workers Association - Atlantis Informal Traders	-A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables. -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Strong network on active community involvement programmed. Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. Minority Black-African communities with a Xhosa cultural background. -Lack of awareness on the historical heritage or indigenous cultures. -Neglecting the existence of diverse cultural groups.

Table 6.11 Levers Assessment, Regenerate strategy water recycling Atlantis precinct

REGENERATE STRATEGY – WATER RECYCLING		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -National Strategy for Sustainable Development (Department of Environmental Affairs, 2011) -National Climate Change Response (2011) -CoCT Resilience strategy (2019)	-East side surrounded by indigenous vegetation Atlantis Sand Fynbos. -Westside surrounded by Agricultural area. -Rural agriculture present on the precinct outskirts -Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant. -Atlantis is infested with large swaths of alien tree species (Gum, Pine, and especially Port Jackson). -Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planning legacy) -Informal settlements WITSAND- lack of services, unstable infrastructure on leisure and recreation/culture (segregation factor)

REGENERATE STRATEGY – WATER RECYCLING		
demography	- Atlantis Skills development program -Atlantis SEZ Community Stakeholder Network	-A strong presence of the Third sector and social cohesion initiatives. -Predominantly young with an average of 30 years -Low interaction between the industry/local community. Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Social Cohesion challenges with vulnerable population: Black-Africans. -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Greentech SEZ Atlantis -Atlantis Investment Facilitation programme -Western Cape Industrial Symbiosis Programme (WISP)	-A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development.
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Strong network on active community involvement programmed. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons .

ADAPT STRATEGY - RETROFITTING INFRASTRUCTURE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -Integrated Resource Plan (Department of Energy, 2011) -National Strategy for Sustainable Development (Department of -Environmental Affairs, 2011) -National Climate Change Response (2011) -CoCT Resilience strategy (2019)	-Majority of Social Housing / formal housing. (houses one-story structure) -A high number of public spaces / civic commons. -A high percentage of industrial infrastructure. -Insecurity perceived in the in the public space and industrial area -Lack of density on the built environment. Sprawl precinct, lack of cohesion and low walkability index. -Informal settlements WITSAND- lack of services, unstable infrastructure -Some buildings of the area in need of significant refurbishment and have been built with materials like Asbestos. -Most energy is sourced by Plant generator coal
demography	-Atlantis SEZ Community Stakeholder Network -CoCT Social Development Strategy	-The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly coloured race population. -Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Greentech SEZ Atlantis -Black Economic Empowerment Model -CoCt Atlantis Investment Facilitation Office -Atlantis Economic Development Trust -Hartebeeskraal Multi-Purpose Community Centre	-Lowest prices of real estate on the City The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -The shops and commerce of the district are concentrated on the precinct centre predominated by a shopping mall, so there are no local shops across the residential areas. -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development.
economy		Since the decline of the precinct, the population skills have not diversified or growth enough. -Workers of Atlantis come outside of the precinct, meaning that the industries can not find the required skills inside the precinct. -Socio-economic degradation -Economic crisis of the area has brought unemployment .

Table 6.12 Levers Assessment, Adapt strategy Retrofitting infrastructure Atlantis precinct

ADAPT STRATEGY - RETROFITTING INFRASTRUCTURE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Considerable amount of worship places due to the broad spectrum of religions present in the area from Christians, Catholics, Lutherans, Anglicans and Muslims; -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan -Cape Malay, a growing sense of belonging. -The cultural identity of the precinct relies upon the community centres. -On overcoming the cultural legacy of apartheid, the community of Atlantis was labelled under the coloured race label. -Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community

Table 6.13 Levers Assessment, Adapt strategy Reuse Infrastructure Atlantis precinct

ADAPT STRATEGY : REUSE INFRASTRUCTURE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -CoCT Urban Settlement Development Grant Funds	-Majority of Social Housing / formal housing. (houses one-story structure) -A high number of public spaces / civic commons. -A high percentage of industrial infrastructure. Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planning legacy) -Lack of accessibility of public space areas from the industrial area -Insecurity perceived in the in the public space and industrial area -Large connectivity spaces for highways (voids). -Informal settlements WITSAND- lack of services, unstable infrastructure -The area does not offer an extended offer on leisure and recreation/ culture (segregation factor) -Presence of 17 post-industrial areas underutilized (urban voids and brownfields) -The area does not offer an extended offer on leisure and recreation/ culture (segregation factor)
demography	-Atlantis SEZ Community Stakeholder Network -CoCT Social Development Strategy	-The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly coloured race population. -Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Precinct presents the characteristics of an enclave (ghetto) a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Population exodus from the area (lack of opportunities young / segregation factor). Leaving space for gangsterism. -Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Greentech SEZ Atlantis -Black Economic Empowerment Model -CoCt Atlantis Investment Facilitation Office -Atlantis Economic Development Trust -Hartebeeskraal Multi-Purpose Community Centre	-Lowest prices of real estate on the City -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development. -Socio-economic degradation (Economic crisis of the area has brought unemployment
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Considerable amount of worship places due to the broad spectrum of religions present in the area from Christians, Catholics, Lutherans, Anglicans and Muslims; -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. -Minority Black-African communities with a Xhosa cultural background. -The cultural identity of the precinct relies upon the community centres. -Organizations are promoting the conservation of the cultural heritage and new urban identities to arouse on one side reflection and sense of belonging by the inhabitants; on the other hand, interest, and attraction for the Atlantis territory -Lack of awareness on the historical heritage or indigenous cultures. On overcoming the cultural legacy of apartheid, the community of Atlantis was labelled under the coloured race label. -Lack of heritage infrastructure, museum or monument. Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community.

Table 6.14 Levers Assessment, Adapt strategy Flexible Infrastructure and Community Atlantis precinct

ADAPT STRATEGY : FLEXIBLE INFRASTRUCTURE AND COMMUNITY		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -CoCT Resilience strategy (2019)	-Majority of Social Housing / formal housing. (houses one-story structure) -A high number of public spaces / civic commons. -A high percentage of industrial infrastructure. -Segregated precinct from the city at 40km from the Cape Town CBD. (Apartheid urban planning legacy) -Lack of accessibility of public space areas from the industrial area Insecurity perceived in the in the public space and industrial area -Commuting limitations,- Isolated precinct due to accessibility - (is not an area attractive to visitors) -Large connectivity spaces for highways (voids). -Lack of density on the built environment. Sprawl precinct, lack of cohesion and low walkability index. -Informal settlements WITSAND- lack of services, unstable infrastructure -The area does not offer an extended offer on leisure and recreation/ culture (segregation factor) -Presence of 17 post-industrial areas underutilized (urban voids and brownfields)
demography	-Atlantis SEZ Community Stakeholder Network -CoCT Social Development Strategy	-The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) Predominantly coloured race population. -Low interaction between the industry/local community. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Greentech SEZ Atlantis -Black Economic Empowerment Model -CoCt Atlantis Investment Facilitation Office -Atlantis Economic Development Trust -Hartebeeskraal Multi-Purpose Community Centre	-Lowest prices of real estate on the City -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -The shops and commerce of the district are concentrated on the precinct centre predominated by a shopping mall, so there are no local shops across the residential areas. -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development. -Since the decline of the precinct, the population skills have not diversified or growth enough. -Workers of Atlantis come outside of the precinct, meaning that the industries cannot find the required skills inside the precinct. Socio-economic degradation (Economic crisis of the area has brought unemployment
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Considerable amount of worship places due to the broad spectrum of religions present in the area from Christians, Catholics, Lutherans, Anglicans and Muslims; -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. -Minority Black-African communities with a Xhosa cultural background. -The cultural identity of the precinct relies upon the community centres. -Organizations are promoting the conservation of the cultural heritage and new urban identities to arouse on one side reflection and sense of belonging by the inhabitants; on the other hand, interest, and attraction for the Atlantis territory -Lack of awareness on the historical heritage or indigenous cultures. -On overcoming the cultural legacy of apartheid, the community of Atlantis was labelled under the coloured race label. -Neglecting the existence of diverse cultural groups. -Lack of heritage infrastructure, museum or monument. -Morphologically the precinct is designed to segregate and eliminates all identity of the Atlantis community. -The precinct's history represents the cultural influence of apartheid policies shaped all aspects from the urban fabric to demographic and economic.

Table 6.15 Levers Assessment, Loop strategy Recycle Atlantis precinct

LOOP STRATEGY : RECYCLE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Integrated Resource Plan (Department of Energy, 2011) -National Strategy for Sustainable Development (Department of Environmental Affairs, 2011) -National Climate Change Response (2011) -CoCT Resilience strategy (2019) -Atlantis Small Farm Association	-East side surrounded by indigenous vegetation Atlantis Sand Fynbos. Westside surrounded by Agricultural area. -Rural agriculture present on the precinct outskirts -Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant. A high percentage of industrial infrastructure. -Presence of Atlantis Waste Drop-off for recycle. Potential for new economic/social purposes. -Informal settlements WITSAND- lack of services, unstable infrastructure -Presence of 17 post-industrial areas underutilized (urban voids and brownfields) -Waste household managed by private operators, direct to dump site on a ratio 50km. (scarce recycling practices). Industrial waste not properly managed -Most energy is sourced by Plant generator coal
demography	C-oCT Social Development Strategy -Atlantis Skills development program -Atlantis SEZ Community Stakeholder Network -Ikamava Youth -Atlantis Alive Youth for Christ -Faith Soup – Kitchen -G-Force Arts and Culture Programme -DreamTeam Committee -Concerned Citizens of Atlantis,- Mamre Council of Stakeholders - Atlantis Council of stakeholders- Witsand consent residents.	-Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.) -A strong presence of the Third sector and social cohesion initiatives. The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years -Predominantly coloured race population. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Population exodus from the area (lack of opportunities young / segregation factor). Leaving space for gangsterism. Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-CoCT Social Development Strategy -Atlantis Skills development program -Atlantis SEZ Community Stakeholder Network -Ikamava Youth -Atlantis Alive Youth for Christ -Faith Soup – Kitchen -G-Force Arts and Culture Programme -DreamTeam Committee -Concerned Citizens of Atlantis,- Mamre Council of Stakeholders - Atlantis Council of stakeholders- Witsand consent residents.	-Biggest employer manufacture sector -A strong presence of Informal commerce, long tradition. They are situated in strategic areas to sale, mainly fruits and vegetables. -24 Circular Business; Biomaterials 5, chemicals 1 , Construction materials 6, Renewable energy, 4, green appliances 2, recycling 6. -Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food-beverages, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and boat builders. -The most significant sector is the 27 Metal & Engineer companies which are mostly large (i.e. Atlantis GRI Renewable Industries wind energy manufacturing - Atlantis Foundries - Hisense, Chinese electronics manufacture). -Population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics. -The Greentech hub aims to encourage CE strategies within the existing manufacturing sectors to become suppliers and component manufacturers for the upcoming green industries. -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -Socio-economic degradation (Economic crisis of the area has brought unemployment Industrial waste not connected to local business activities -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development. -Since the decline of the precinct, the population skills have not diversified or growth enough. -Workers of Atlantis come outside of the precinct, meaning that the industries cannot find the required skills inside the precinct. -The shops and commerce of the district are concentrated on the precinct centre predominated by a shopping mall, so there are no local shops across the residential areas. -The industrial waste as the household waste is very challenging to monitor as every company hires its own waste collector company.

LOOP STRATEGY : RECYCLE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Strong network on active community involvement programmed. Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. Minority Black-African communities with a Xhosa cultural background. -Lack of awareness on the historical heritage or indigenous cultures. Neglecting the existence of diverse cultural groups.

LOOP STRATEGY : REUSE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-CoCT Municipal Spatial Development Framework (2018) -CoCT Resilience strategy (2019)	-Atlantis Water Resource Management Scheme: Underground Water storage infrastructure / Stormwater basins / Water treatment plant. -A high percentage of industrial infrastructure. -Presence of Atlantis Waste Drop-off for recycle. Potential for new economic/social purposes. -Informal settlements WITSAND- lack of services, unstable infrastructure -Presence of 17 post-industrial areas underutilized (urban voids and brownfields) -Waste household managed by private operators, direct to dump site on a ratio 50km. (scarce recycling practices). Industrial waste not properly managed
demography	-CoCT Social Development Strategy -Atlantis Skills development program -Atlantis SEZ Community Stakeholder Network: -Ikamava Youth -Atlantis Alive Youth for Christ -Faith Soup - Kitchen -G-Force Arts and Culture Programme -DreamTeam Committee -Concerned Citizens of Atlantis,- Mamre Council of Stakeholders - Atlantis Council of stakeholders- Witsand consent residents	-Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.) -A strong presence of the Third sector and social cohesion initiatives. The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years -Predominantly coloured race population. -Socio-economic degradation (Economic crisis of the area has brought Unemployment). -Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Population exodus from the area (lack of opportunities young / segregation factor). Leaving space for gangsterism. Post-apartheid Socio-economic degradation. Peri urban precinct scarce growing of new generations. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-Greentech SEZ Atlantis -Ten Year Innovation Plan, 2008 – 2018 (South Africa Department of Science & Technology) -Atlantis Investment Facilitation programme -Black Economic Empowerment Model -CoCt Atlantis Investment Facilitation Office -Atlantis Business Chamber Atlantis Unions -Western Cape Industrial Symbiosis Programme (WISP) -Atlantis Economic Development Trust -Saxon Sea Community Developments Project: -Hartebeeskraal Multi-Purpose Community Centre: -Atlantis Unrestricted Workers Association - Atlantis Informal Traders	-Biggest employer manufacture sector -A strong presence of Informal commerce, long tradition, situated in strategic areas to sale, mainly fruits and vegetables. -24 Circular Business; Biomaterials 5, chemicals 1, Construction materials 6, Renewable energy, 4, green appliances 2, recycling 6 . -Industrial waste present for potential symbiosis and by industry: Metal & Engineer, Plastics, Food-beverages, Chemicals, Glass, Wood, Electronics Textiles, Construction, Agriculture and boat builders. -The most significant sector is the 27 Metal & Engineer companies which are mostly large (i.e. Atlantis GRI Renewable Industries wind energy manufacturing - Atlantis Foundries - Hisense, Chinese electronics manufacture). -Population employed in Atlantis precinct is 27.897 (predominantly coloured), most of their skills are in Retail, manufacture and electronics. -the Greentech hub aims to encourage CE strategies within the existing manufacturing sectors to become suppliers and component manufacturers for the upcoming green industries. -The interaction between the Greentech SEZ and the community is slowly progressing through the Atlantis SEZ Community Stakeholder Network. -Socio-economic degradation (Economic crisis of the area has brought unemployment Industrial waste not connected to local business activities -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development.

Table 6.16 Levers Assessment, Loop strategy Reuse Atlantis precinct

LOOP STRATEGY : REUSE		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Strong network on active community involvement programmed. -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons / -The predominant cultural groups are coloured Griqua - Khoisan - Cape Malay, a growing sense of belonging. -Minority Black-African communities with a Xhosa cultural background.

LOOP STRATEGY : ENERGY RECOVERY		
	CURRENT LEVERS - POLICIES & PROJECTS	TERRITORIAL ASSETS - POTENTIAL LEVERS
urban fabric	-Integrated Resource Plan (Department of Energy, 2011) -National Strategy for Sustainable Development (Department of Environmental Affairs, 2011) -National Climate Change Response (2011) -CoCT Resilience strategy (2019)	-A high percentage of industrial infrastructure. Informal settlements WITSAND- lack of services, unstable infrastructure -Presence of 17 post-industrial areas underutilized (urban voids and brownfields) -Waste household managed by private operators, direct to dump site on a ratio 50km. (scarce recycling practices). -Most energy is sourced by Plant generator coal
demography	-CoCT Social Development Strategy -Atlantis Skills development program -Atlantis SEZ Community Stakeholder Network -Ikamava Youth-Project	-Presence of education infrastructure eight primary schools- 4 secondary schools. (Available infrastructure.) -A strong presence of the Third sector and social cohesion initiatives. -The public services and infrastructure consist of 16 facilities of public services between (libraries, theatres, community centres, police station) -Predominantly young with an average of 30 years -Predominantly coloured race population. Socio-economic degradation (Economic crisis of the area has brought Unemployment).
demography		-Precinct presents the characteristics of an enclave (ghetto): a concentration of people with a high incidence of social problems (from alcoholism to gender violence), a strong cultural and religious mix, physically isolated and socially separated from the city. -Not enough job opportunities for the local population. The young population are at high risk of school dropout, due to the degradation of the precinct (gangsterism) with a high risk of exclusion and poverty. -Mistrust on the government, as past policies have not fulfilled promises. A long past of failed socio-economy to plans on the area.
economy	-GreenTech SEZ Atlantis: Greentech industrial park in Atlantis (Special Economic Zones Bill in Government Gazette No. 36203 of 1 March 2013 (Department of Trade and Industry, 2014); -Ten Year Innovation Plan, 2008 – 2018 (South Africa Department of Science & Technology) -Atlantis Investment Facilitation programme -Black Economic Empowerment Model -CoCt Atlantis Investment Facilitation Office- -Atlantis Business Chamber -Atlantis Economic Development Trust -Saxon Sea Community Developments Project -Hartebeeskraal Multi-Purpose Community Center	-The interaction between the GreenTech SEZ and the community is slowly progressing through the Atlantis SEZ -Community Stakeholder Network. -Socio-economic degradation - Economic crisis of the area has brought unemployment -The abandonment of government subsidies as a main economic actor brought a low amount of entrepreneurial activity and a decline in infrastructure property value. -The unemployment rate is considerably high 26% this has to do with issues social issues as alcoholism, lack of opportunities and skills development. -Since the decline of the precinct, the population skills have not diversified or growth enough. -Workers of Atlantis come outside of the precinct, meaning that the industries can not find the required skills inside the precinct.
culture	-Griqua Royal house -Khoi-san renaissance cultural awareness -Atlantis First Indigenous peoples community	-Strong network on active community involvement programmes. -Rebuild the cultural identity factor as a tool for social cohesion. -Ongoing Processes of social activism that allow the involvement of citizens in the care of civic commons

Table 6.17 Levers Assessment, Loop strategy Energy recovery Atlantis precinct

6.8 Implementation

After overviewing what policies and assets of the Atlantis precinct are levers to activate strategies towards a Circular City model, this stage of the research focused on establish system dynamics through concrete implementations for each strategy of the main Circular Actions (as explained in section 4.7.1). According to the time-Based Design approach, the implementations of the main Circular Actions allowed comprehending the system dynamics (Figure 4.7). To achieve that each strategy was analysed according to the procedure established in (Table 4.4) through implementation, status (executed, planed, implementation) and cross-cutting action, in the following (Table 6.18)(Table 6.19)(Table 6.20).

The analysis of the main Circular Actions implementations will be followed by a research synthesis of the Localize and Optimize Circular Actions within the Atlantis precinct. Lastly, a brief description of the role of supportive actions the Atlantis precinct.

REGENERATE STRATEGIES

According to the table Table 6.18 the Regeneration strategies identified are mostly reliant in government support, and some are executed cross the precinct. In this particular case, the levers and the evidence on the precinct presented that the Regenerate Circular Action is one of the most consolidated:

- *Green Walls:* This strategy is planned to spread out as localized pilots from the SEZ infrastructure. This strategy actively involves a plan to involve all industries in the precinct to retrofit their building with greenery. To involve the community, potential Green wall interventions are proposed in schools and community centres. Most of these future implementations come from public funding and partnerships with industries and government.

- *Community urban farming:* This strategy is well established on the outskirts and the third sector. These strategies actively include a wide variety of community members involving the strong sense of belonging, striving to promote a participatory process and co-management for the maintenance of the urban farms and create awareness on food security. In order to spread broader, the indigenous cropping practices, potential interventions could be in schools and community centres. Such implementation comes from public funding and partnerships with the third sector and education (Research).
- *Pollinator Biodiversity*; This potential strategy aims to connect the precinct bringing a corridor of biodiversity species on the industrial area. This strategy actively involves the government and industry members to create a coordinated action to create awareness on biodiversity impacts on walkability and public health. These implementations come from public funding and partnerships with industry and government.

- *Water recycling:* Atlantis Water Resource Management Scheme has successfully restored and recycled water for more than three decades. This strategy provided the community with an alternative of blue infrastructure source of natural water supply. Moreover, it actively involves a broader range of precinct stakeholders, creating awareness of blue infrastructure and water supply.

Overall implementation of Regeneration strategies is starting to be integrated across the precinct, to restore the indigenous ecosystems and reinforce the sense of belonging. This strategy will be boosted by the arrival of the SEZ, which not only will bring green companies, but it aims to transform the precinct in a green living lab. Through the SEZ, the aim is to influence future precinct plans and ensure natural corridors between all precinct areas and access to green infrastructures with high recreational and conservation values which have mental and physical health benefits.

The blue infrastructure implementation has proven to be an example of resilience within natural resources and regeneration. The water recycling scheme safe the precinct from the exceptional drought that CoCT suffered in 2018, almost becoming the first metropolis to run out of water.

The introduction of blue-green infrastructure into Atlantis precinct will create jobs associated

REGENERATE					
STRATEGY	IMPLEMENTATION	DESCRIPTION	STAKEHOLDERS	STATUS	CROSS-CUTTING ACTIONS
Green Walls	Green wall at Community centers	Outdoor green wall, with indigenous vegetation. Participatory design process and co-management for the maintenance of the green walls with the users.	Government Third Sector	Potential	adapt
	Green wall at informal settlements	Retrofitting action with implementing green walls on WITSAND informal settlements Outdoor self-supporting green wall, to create thermal isolation effect winter /summer.	Government Third Sector Education /Research	Potential	adapt
	Green Wall at school	Green indoor wall with local indigenous vegetation. Participatory processes and co-management for the maintenance of the green walls with the students and the school staff.	Government Education /Research	Potential	adapt
	Green roof/ Walls at SEZ	SEZ industries will include outdoor green wall and roof, with indigenous vegetation. To create green corridors and increase the walkability index in the industrial area.	Government Industry	Planed	adapt
Community urban farming	Community school gardens	Integration of educational gardens (indigenous vegetation) and scientific laboratories aimed at primary and high schools.	Education Third Sector	Potential	adapt / loop/ sharing
	Third sector organization gardens	Educational garden for disadvantaged people manged by the third sector, educational area for training and association activities.	Third Sector	Executed	adapt / loop
	Rural community garden	Small scale rural gardening on the outskirts of Atlantis.	Government Third Sector	Executed	adapt / loop/ sharing
	Community center gardens	Placing of fixed containers for urban horticulture, for community local cropping or demonstrations on indigenous vegetation.	Government Third Sector	Potential	adapt / loop/ sharing
Pollinator Biodiversity	Pollinator corridor	Pollinator corridor for native species. Plants to connect with the nature reserve, create several biodiversity corridors through the industrial area and towards the residential area. (Proposal to start in the SEZ)	Government Industry	Potential	adapt
Water recycling	Atlantis water scheme	Atlantis Water Resource Management Scheme uses water treatment to processes wastewater and stormwater into large basins where it is infiltrated into a sandy aquifer from where it is abstracted and reused for local water supplies (30% of Atlantis' groundwater supply is augmented through artificial recharge)	Government	Executed	loop

Table 6.18 Implementation, Regenerate strategy Green walls ,Community farming, Pollinator Biodiversity , and Water Recycling Atlantis precinct

with maintenance, conservation and recreational strategies. The implementation of regeneration strategies will increase indigenous biodiversity and vegetation.

ADAPT STRATEGIES

According to table 6.19 the adapt strategies identified are planned or potential across the precinct. Therefore, the levers and the evidence on the precinct presented that the Adapt Circular Actions still need more support to be consolidated:

- *Retrofitting infrastructure:* This strategy aims to reinforce the optimise actions in the precinct, bringing energy efficiency on housing, Industrial and public buildings. In particular, it is aimed to be actively involved with community members, industry and government, in order to develop a participatory process to foster energy transition plans. The strategy identified target implementations retrofitting circular business model within Atlantis precinct. On that way, the retrofitting infrastructure strategy can be scaled up and disseminated through all the precinct infrastructure. Most of these future implementations come from public funding.

- *Reuse Infrastructure;* This strategy aims to reactivate and connect the underutilised infrastructure precinct such as civic commons public buildings and post-industrial sites in Atlantis. This action is strongly influenced by the Atlantis SEZ, reusing post-industrial land. Also, it actively involves community members and industry aiming to develop a participatory process and co-management and maintenance of this deprived infrastructure activating for the new circular activities (social innovation strategies, local businesses NBS strategies). Moreover, these implementations could work as a tool for social cohesion in the Atlantis precinct, serving services that fit better vulnerable population (Black Africans, unemployed youth). Most of this future implementation need to be planted in partnerships between government and the third sector.

- *Flexible Infrastructure and Community:* The identified strategies aim to foster the capacity of third sector organizations to generate or enhance local social networks, most of them are currently executed in Atlantis precinct. These strategies actively involve a broader range of stakeholders (from community members, industry and Third sector organizations) aiming to make awareness and promote platforms to enhance local culture supporting local platforms, products and Pop-up events (workshops – festivals) that promote public infrastructures, social housing, civic commons and post-industrial sites. In order to promote such flexibility in the infrastructures, the researcher identified that it could be supported by a circular business model for flexible infrastructures, which ensures stable operation over time. The implementations are solidly backed by substitute actions (discussed in the next section) which foster the social cohesion and resilience among the community. Most of these future implementations come from partnerships with industry and the third sector.

Overall implementation of adapt strategies for the Atlantis precinct requires to integrate on future physical planning, adding long-term robustness and flexibility, in order to be climate, social and economic resilience (overcome the mistrust that the community has). As the precinct is divided into four different areas, the upcoming Greentech SEZ is a not-to-be-missed opportunity to foster adapt strategies that generate cohesion and connectivity across the precinct. These strategies reflect the new implemented uses for Atlantis precinct infrastructures in order to be resilient must meet today's cultural and economic interests generating a strong sense of belonging.

The strategies foster the adaptive capacity of the Atlantis stakeholders to be engaged in decision-making processes. In order to generate adapt implementations, all stakeholders must have an understanding of challenges and potential solutions to develop networks through which they can self-organise, a proof of that is the current Atlantis SEZ Community Stakeholder Network.

Table 6.19 Implementation Adapt strategy, Retrofitting infrastructure, Reuse Infrastructure, and Flexible Infrastructure and Community Atlantis precinct

ADAPT					
STRATEGY	IMPLEMENTATION	DESCRIPTION	STAKEHOLDERS	STATUS	CROSS-CUTTING ACTIONS
Retrofiting infrastructure	Retrofitting informal settlement	Retrofitting action with implementing green walls on WITSAND informal settlements Outdoor self-supporting green wall, to create thermal isolation effect winter /summer.	Government Third Sector	Potential	regenerate
	Retrofitting industrial buildings	Retrofitted green roofs and walls and improvements in thermal comfort. Implementation of retrofitting actions facade insulation and renewable sources for heating in New and old industrial infrastructure.	Government Industry	Planed	regenerate
	Retrofitting business model	Implementation of a municipal circular business model for retrofitting implementation on industrial and housing infrastructure. (low real state prices - ideal for bringing investors)	Government Industry	Potential	loop
	Retrofitting public buildings /housing	Retrofitted green roofs and walls and improvements in thermal comfort: Public buildings, social housing and historical infrastructure. Implementation of retrofitting actions facade insulation and renewable sources for heating	Government Third Sector	Potential	regenerate
Reuse Infrastructure	Reuse public infrastructure	Reuse public infrastructure such as libraries, community centres, To encourage Circular Strategies to o repurpose for local, new businesses, engaged with the local community, resources and community heritage. (NBS strategies or social innovation strategies) such as repair, reuse, i.e. Public Tool Library).	Government Third Sector	Potential	regenerate/ loop /sharing
	Reuse of industrial voids	Reuse of abandoned industrial land for national re-industrialization plans—Atlantis Green-tech Special economic zone.	Government Third Sector	Executed	regenerate/ loop /sharing
Flexible Infrastructrue and Community	Flexible community	Flexible community; a large number of third sector organisations through activities for all population targets (shows capacity to learn, strong social networks for learning, etc.). Enhance the diverse local ethnical groups). Through periodically Pop up community events (workshops - festivals) supporting local products, heritage or social cohesion. (Schools- Public infrastructure).	Education/ Research Third Sector	Executed	regenerate/ loop
	Pop-up events civic commons	Pop events on civic commons or commercial streets to reinforce the local products industry local food heritage second-hand products and exchange practices reuse second hand. The pop-up reuse centre enables residents to recycle repair or swap household items close to their home	Government Third Sector	Planed	loop , sharing, substitute
	Flexible Social Housing	Adapting housing to create a stronger network of neighbors, through promoting sharing actions.(Communal apps, info about sharing, goods or community services). Flexible services in Witsand .	Government Third Sector	Planed	regenerate, sharing, substitute
	Events Circular Business model	Circular Business Model to make sustainble and constat the pop activities in the industrial voids	Third Sector	Potential	loop

LOOP STRATEGIES

According to the table Table 6.20, the loop strategies identified have a significant executed basis. However, most identified strategies are potential across the precinct. In this particular case, the levers and the evidence on the precinct presented that the Loop Circular Actions still need more support to be consolidated:

- *Recycle:* This strategy on regards the household waste has two influential milestones (Organic waste collection and Recycling Drop off station) which are increasing in awareness among the local community in Atlantis. These strategies have actively involved a broader range of community members aiming to develop a participatory process for recycling practices. On the side of the industrial waste, it was identified as a spectrum of strategies that can include the industrial sector more actively in the recycling strategies of the precinct. Some strategies involved the Greentech SEZ in the role of promoting more recycling industries and regenerating urban voids. Furthermore, another strong strategy is the waste symbiosis between industries supported by the WISP - material flow analysis database of Atlantis industries. Most of these future implementations come from public funding and partnerships with the third sector.

- *Reuse:* Most of the strategies identified are potential across the Atlantis precinct. These strategies actively involve a broader range of stakeholders (from community members, industry and Third sector organizations) aiming to make awareness and promote platforms to network reuse of products and services present in the Atlantis precinct. Moreover, the research identified that there is the potentiality to include the promotion of repair businesses within the current upcoming of the Greentech SEZ as a potential green sector. These strategies approach from promoting more intends of government incentives to generate new enterprises on a repair business model. Most of these future implementations come from public funding and partnerships with the third sector.

- *Energy Recovery:* This strategy aims to reinforce the optimise actions in the precinct, bringing energy efficiency. Currently, the presence of Solar Off-grid energy pilots in Witsand informal settlement are leading the energy recovery strategies. The solar lights promote urban safety and Wi-Fi, creating local economic empowerment opportunities for the Atlantis community. These strategies are aimed to have actively involved with community members and government in order to develop a participatory process to foster energy transition plans. This future implementation comes from a public funding perspective.

The implementation of loop strategies is starting to be integrated across the precinct, to reduces the amount of waste going to landfill and rendering an energy alternative to fossil fuels, clearly the arrival of the Greentech SEZ has influenced this transition. This looping decreases the wastage of resources and avoids the environmental and economic expenses of landfill and pollution. Moreover, looping actions will also create jobs mostly on the emerging industrial symbiosis businesses. However, this will require significant effort from the government as opportunities for repair, remanufacturing of waste materials is under-developed in the Atlantis precinct.

LOCALIZE AND OPTIMIZE ACTIONS

As described in the framework (Figure 4.5), the localise and optimised Circular Actions are at the base of implementation of the Circular City model. On that view, after describing the implementations of the main Circular Actions, it is relevant to do a brief research synthesis to overview where these actions are represented in the circular model for Atlantis precinct.

As localise action is one of the pillars of Systemic Design approach where the city flow resources must find local synergies in order to decrease energy utilised, emissions produced and resource decoupling—establishing local symbiotic capital required to promote sustainable good-practices needed for looping, adapting and regeneration actions. On a second layer, as described in the

Table 6.20 Implementation strategy, Loop strategy Recycle, Reuse and Energy recovery Atlantis precinct

LOOP					
STRATEGY	**IMPLEMENTATION**	**DESCRIPTION**	**STAKEHOLDERS**	**STATUS**	**CROSS-CUTTING ACTIONS**
Recycle	**Organic waste collection**	Municipal separate organic waste collection. To ensure less organic waste ends up in landfills. Residents are being encouraged to apply for a free home composting container.	Government	Executed	regenerate
	Recycling Drop off station	Drop off station for household Municipal separate collection -Glass - Plastic - Paper. Sent to recycling facilities for material recover.	Government	Executed	adapt
	Recycle Education programs /campaigns	Third Sector organisations involved in the collection of recycling material, education activities to trained and inform the community on circular strategies. Consumers are supporting local businesses with household waste material for new value chain opportunity.	Government Third Sector Education/ Research	Executed	adapt
	Symbiosis between industry and SMEs by WISP	Businesses with material waste supporting local activities r new entrepreneurial activity. For example: Local Pallet recycling for wood chipping, Local Textile waste collection for shredding, Shredder for supplying the underfelt manufacturers (among other upcoming activities).	Government Industry Third Sector Education/ Research	Executed	adapt
	Incentives bussines model based on recycling - green/ byproduts	The Greentech SEZ Implement a circular business scheme in the area where local recycled/ green resources are the base, another definition of reindustrialisation of the area.	Government Industry Education/ Research	Planed	regenerate, adapt
	Industry incentives for recycle urban void	The GreenTech SEZ involved businesses in the rehabilitation/ recycle of public abandoned land and infrastructure. (Incentives from the government for looping activities in the built environment)	Government Industry	Planed	adapt
Reuse	**Platforms repair local products services**	ICT Tools / APPs to network with the community on CE activities, to promote the repair services and reuse goods available.	Government Third Sector Education/ Research	Potential	regenerate, adapt, sharing, substitute
	Incentives bussines model based on industrial repair	Enhance the industrial repair capacity of the precinct, an opportunity for the manufacturing industry to diversify their portfolio. (Introduce Repair as a business model for the Greentech SEZ)	Government Third Sector	Potential	regenerate, sharing, substitute
	Awarness Events for share / repair	Third Sector organisations involved in empowering the strong sense of belonging present in the community through the promotion of reuse objects and repairing. Promoting their material culture and social cohesion. i.e. Tool Libraries, repair cafe's workshops.	Third Sector Education	Planed	adapt, sharing,
Energy Recovery	**Solar Off-grid energy informal settlements**	These solar lights provide area lighting; they also enhance safety and security in the surrounding area. Moreover, they provide wifi which improves conditions in an area and has created a demand for these services.	Government Industry	Executed	adapt

framework (Figure 4.5), the optimised action is the capacity to optimise the consumption and production of resources through the adoption of efficient value chains. On that view in the Atlantis precinct, this action was an approach as follows:

- *Regeneration:* Enhancing the belt of indigenous vegetation Atlantis Sand Fynbos through creating biodiversity corridors across the precinct. Promoting local consumption of locally produced crops goods. Localised and optimised water consumption through existing water recycling scheme (see Table 6.18)

- *Adapt:* The localised development of the upcoming Greentech SEZ aims to develop industrial voids and post-industrial infrastructure to be flexible and adaptable enough that meets today's cultural and economic interests —enhancing local culture within local communities and their infrastructure. (see Table 6.19)

- *Loop:* The industrial sector plays a central role in reducing the amount of waste going to landfill, promoting the flow of local resource through industrial symbiosis strategies. Moreover, the Solar Off-grid energy informal settlements can be scaled up into other areas of the precinct optimising the use of locally produce an energy alternative to fossil fuels. (see Table 6.20)

These implementations support the localisation and optimisation of local resources in living and industrial functions, which enhances local economy, environment and local communities, creating local value and making a resilient circular system.

SUPPORTING ACTIONS

As described in the framework (Figure 4.5), the supporting actions share and substitute Circular Actions reinforce the implementation of the Main Circular. After describing the implementations of the main Circular Actions, it is relevant to do a synthesis of the role of supportive actions the Atlantis precinct.

As sharing action is the capacity to exchange resources in cities across a range of activities from local livelihoods to city infrastructure goods, in order to decouple resource consumption and waste production-practices needed for looping, adapting and regeneration actions. At the same time, the substitute actions replace resources, services and infrastructure for renewable choices or virtualization to decouple the consumption of resources in cities. On that view in the Atlantis precinct, this action was an approach as follows:

- *Regenerate:* The sharing actions are focused on the community garden implementation where potential collaboration with informal traders community and the local community. (see Table 6.18)

- *Adapt:* The sharing and substitute actions are involved in the Flexible Infrastructure and Community action, which promotes platforms for sharing activities to enhance local culture supporting local, products and Pop-up events (workshops - festivals). (see Table 6.19)

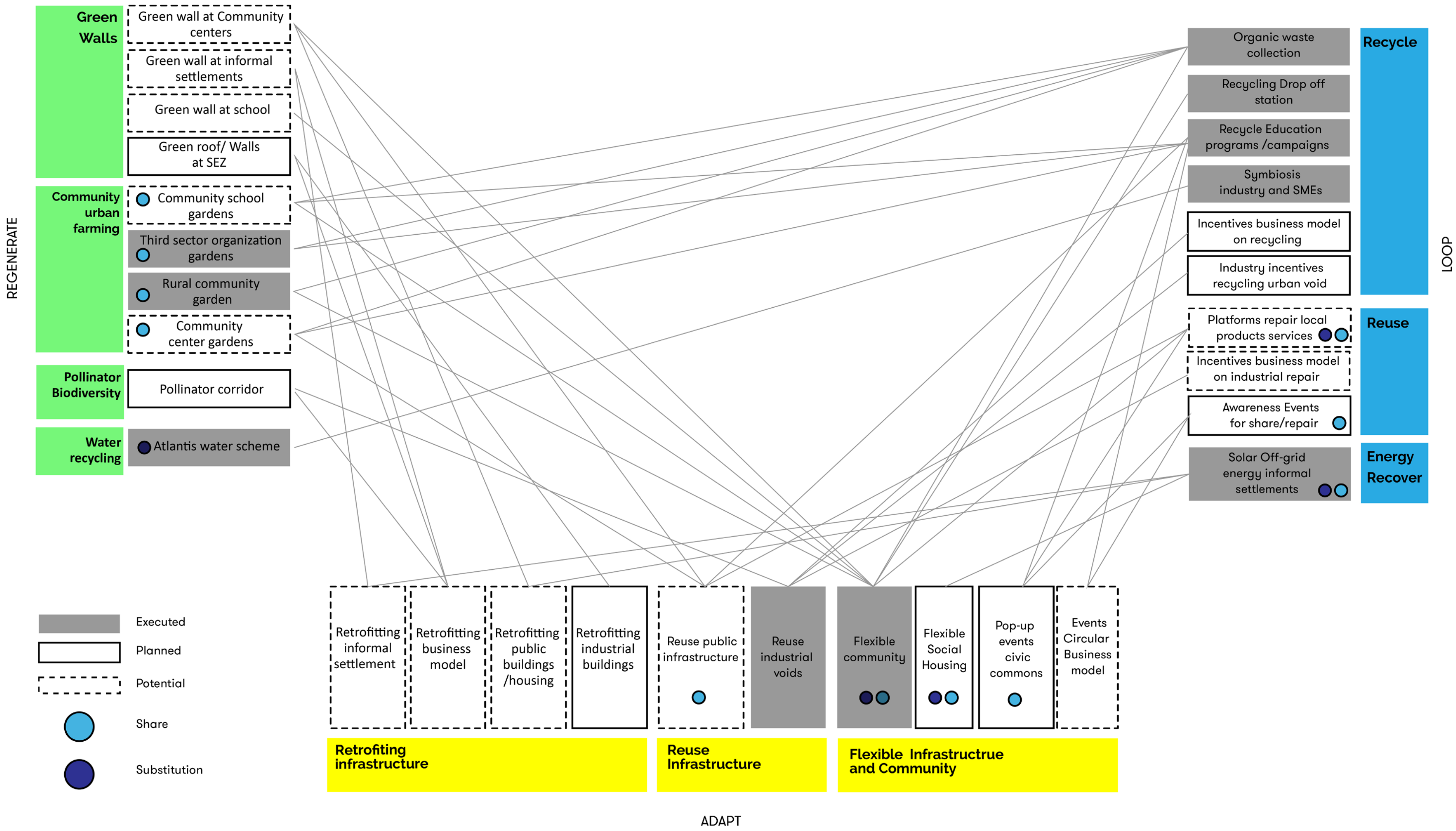
- *Loop*: The sharing actions are involved in the recycling and reuse campaigns among the local community. More specifically, in substitute, the Solar Off-grid energy system in informal settlements is replacing the fossil fuel energy sources. (see Table 6.20)

CIRCULAR ACTIONS DYNAMICS

As described in section 4.7, the relation between the implementation of the Circular Action should generate a systemic dynamic (Figure 4.7), which will allow the understanding the gradual implementation of a Circular City model in the Atlantis precinct. After overviewing the Atlantis Circular Action implementations (Table 6.18)(Table 6.19)(Table 6.20), the researcher prepared a synthesis of some of the synergies between Circular Actions (Figure 6.49). On the representation is reflected if the implementation is potential, planned or executed as this will influence the development between the dynamics.

On that view, the research found some exemplification on the relations of its synergies. For example,

Figure 6.49 Atlantis precinct Circular Actions Dynamics


REGENERATE
Green Walls
Green wall at Community centers
Green wall at informal settlements
Green wall at school
Green roof/ Walls at SEZ
Community urban farming
Community school gardens
Third sector organization gardens
Rural community garden
Community center gardens
Pollinator Biodiversity
Pollinator corridor
Water recycling
Atlantis water scheme
Organic waste collection
Recycling Drop off station
Recycle Education programs /campaigns
Symbiosis industry and SMEs
Incentives business model on recycling
Industry incentives recycling urban void
Recycle
Platforms repair local products services
Incentives business model on industrial repair
Awareness Events for share/repair
Reuse
Solar Off-grid energy informal settlements
Energy Recover
LOOP
Executed
Planned
Potential
Share
Substitution
Retrofitting informal settlement
Retrofitting business model
Retrofitting public buildings /housing
Retrofitting industrial buildings
Reuse public infrastructure
Reuse industrial voids
Flexible community
Flexible Social Housing
Pop-up events civic commons
Events Circular Business model
Retrofitting infrastructure
Reuse Infrastructure
Flexible Infrastructrue and Community
ADAPT

Atlantis water scheme (regenerate) regenerates the water resource for other local activities (loop). Similarly, community farming implementations (regenerate) are closely related to the organic waste collection strategy and recycling awareness programs (loop) looping all organic resources in the precinct. Also, the regeneration strategies on community green walls, urban community farming and pollinator implementations strongly depend on adaptation strategies like Flexible Infrastructure and Community, in order to have a successful implementation.

Further, the impact of the upcoming Greentech SEZ is visible across all Circular Actions. For instance, the Greentech SEZ will foster the reuse of post-industrial voids bringing green enterprises (adapt) supporting the symbiosis of SMEs and industry, creating new value chains (loop). At the same time that adapts the urban voids, the green industrial hub will promote urban greenery (walls and pollinator corridors) to overcome the physical segregation experienced between the residential and the industrial area. Also, this aims this regenerate action aims to influence the retrofitting (adapt) strategy with natured based solutions.

With this in mind, the "loop" Circular Action is one of the most consolidated. The key lever is the implementation of recycling strategies as the mostly executed or planed are substantial leverage to activate the Atlantis circular system at industrial (i.e. Symbiosis industry and SMEs) and household level (i.e. Recycling Drop off station). Also, the energy recovery strategy on off-grid solar panels can be a critical strategy to activate adaptation strategies bringing new economic and social activities to the precinct.

About the adapt actions, which is an action with the most synergies, however, is not yet consolidated (most actions potential). Nevertheless, the socio-economical degradation of the precinct implementation makes inevitable that action with more synergies is Flexible Infrastructure and Community, which entails that the transition to circularity most includes a substantial involvement social component that can generate cohesion and resilience.

Even though it has enormous ecological potential by the indigenous vegetation ecosystem that surrounds, the regeneration action is mostly underdeveloped. With that in mind, the critical lever to activate the regeneration strategies is the community farming implementation it poised as the action with the most synergies.

Within an embodiment of the dynamics between the Atlantis precinct actions, it can distinguish the which actions which are more likely to endure over time successfully, in this case, the Greentech SEZ implementation process will influence the resilience of the potential circularity. The purpose of this dynamic is a gradual transition that should create local value and deliver more realistic and feasible new economic, environmental and participatory activities.

6.9 Results analysis and feedback

After approaching the implementations and the circular system dynamics of the Atlantis precinct, this final step implied the assessment of the Circular Actions (or new circular system) (as explained in section 4.7.1). For that aim, the main Circular Actions were analysed in two parts through the lens of the Circular Economy Barriers (Table 2.3) and Impact Indicators (Table 4.5).

Taking in consideration the literature review (see Chapter 2) on Systemic Design approaching CE barriers was identified a range of barriers in implementing the proposed CE in Atlantis precinct (Table 6.21)(Table 6.22)(Table 6.23). The challenges of Atlantis' current dynamics to support a Circular City model are correlated to the pressure for systemic cultural change from all stakeholders involved; community, industry, government and research. Moreover, the study findings identified significant barriers (regulatory, economic, cultural, institutional, and technical) for developing levers to activate the proposed circular implementations.

For instance, the more technical challenge is faced by Loop strategies (Table 6.23), than Regenerate strategies (Table 6.21), as both have a significant criticality in local skills development (Table 6.6). Equally, Loop (Table 6.23), Adapt (Table 6.22) and Regenerate strategies (Table 6.21), have critical institutional barriers (Table 6.7). Unfortunately, in the Greentech SEZ is starting to occur such bureaucratic barriers. Therefore, the information incorporated in the (Table 6.21)(Table 6.22)(Table 6.23) intends to present a summary of what difficulties these implementations face in the Atlantis context. Nevertheless, there are six barriers which cut across resources and actions in the Atlantis precinct: Absence of trust in policymakers, scarce institutional support, Absence of a supportive regulatory framework, dependence on the private expense, Absence of operational conditions (local skills) and current cultural values. These are the barriers if addressed, can work as a leverage to maximise the impact of the Circular Action and reduce the effects of the enlisted barriers.

Therefore, to verify if the implementations have overcome such barriers (Table 6.24)(Table 6.25)(Table 6.26) are presented the anticipated impacts for each Circular Action, as the second part of

REGENERATE		
STRATEGY		MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION
Green Walls	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure, Not reaching a Circular Bussiness Model,Economic viability, Need of financial incentive.
	Cultural	Current value and norms, Current social practices, Cultural diversity, Public unawareness with natural environment, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions
	Institutional	Cultural and structural inertia, Absence of cross-sector alliance, Absence of institutional capability, Managing authorities with limited controls/capabilities/resources, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers
Community urban farming	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure, Not reaching a Circular Bussiness Model, Economic viability, Need of financial incentive.
	Cultural	Current value and norms, Current social practices, Cultural diversity, Public unawareness with natural environment, Current lifestyles
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers
Pollinator Biodiversity	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planing regulations land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure. Not reaching a Circular Bussiness Model,Economic viability, Need of financial incentive.
	Cultural	Current value and norms, Current social practices, Cultural diversity, Public unawareness with natural environment, Current lifestyles
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers
Water Recycling	Regulatory	Regulations on interventions of public buildings or civic common, Urban Planning regulations on industrial land use, Absence of a supportive framework for Natured Based solutions.
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure, Not reaching a Circular Bussiness Model,Economic viability, Need of financial incentive.
	Political	Neoliberalism, Require for long-term political support.
	Institutional	Lack of availability of land due to regulations, Fragmented government, Absence of cross-sector alliance, Managing authorities with limited controls/capabilities/resources, Absence of commitment with civil society, Absence of trust in policymakers

Table 6.21 Main barriers to Circular Economy implementation Regenerate strategy Atlantis precinct

ADAPT		
STRATEGY		MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION
Retrofitting infrastructure	Regulatory	Regulations on interventions of public buildings or industrial, Urban Planning regulations on the energy grid, Absence of a supportive framework for retrofitting
	Economic	Guarantee of continuous funding to maintain the potential green infrastructure. Not reaching a Circular Bussiness Model, Operational costs, Lack of financial incentive, Lack of public investment and reliance on private investment, Need of financial incentive, Financial risk, Absence of public expenditure and dependence on private expense.

Table 6.22 Main barriers to Circular Economy implementation Adapt Atlantis precinct

ADAPT		
STRATEGY		MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION
Retrofitting infrastructure	Cultural	Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions (local skills), Current linear resource flows
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers
Reuse Infrastructure	Regulatory	Urban Planning regulations on industrial land use, Regulations on interventions of public buildings
	Economic	Guarantee of continuous funding reuse buildings, Not reaching a Circular Bussiness Model, Operational costs, Lack of financial incentives, Lack of public investment
	Cultural	Not enough enviromental awarness from local actors, Not enough enviromental awarness from civil servants, Current value and norms, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society.
Flexible Infrastructrue and Community	Regulatory	Urban Planning regulations on industrial land use, Regulations on interventions of civic commons Regulations on interventions on industrial polluted sites, Absence of supportive framework, Regulations on interventions of public buildings.
	Economic	Guarantee of continuous funding, Operational costs, Lack of financial incentives, Lack of public investment and reliance on private investment, Absence of public expenditure and dependence on private expense
	Cultural	Not enough enviromental awarness from local actors, Not enough enviromental awarness from civil servants, Current value and norms, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with natural environment, Current lifestyles
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers

LOOP		
STRATEGY		MAIN BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION
Recycle	Regulatory	Absence of a supportive framework for recycling, Lack of regulations on byproducts from polluted material, Emerging models for looped resources.
	Economic	Economic viability, Not reaching a Circular Bussiness Model, Limited demand for looped resources, Global Supply chain and global market effect of sustaining those activities/linear resource system, Cost of dealing with contamination or invest in the recycling process.
	Cultural	Not enough environmental awareness from local actors, Presence of the incinerator affects the waste separation on the precinct, Current social practices, Cultural diversity, Public unawareness of resource cycle, Public unawareness with the natural environment, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions (local skills), Current linear resource flows
	Institutional	Lack of availbility of land due to regulations, Recycling sites remain in the moyority out of the precinct, Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymakers
Reuse	Regulatory	Lack of incentives for repair facilities on civic commons, Absence of a supportive framework for reuse or repair, Emerging models for looped resources, Regulations on interventions of public buildings or civic commons.
	Economic	Economic viability, Not reaching a Circular Bussiness Model, Limited demand for looped resources, Global Supply chain and global market effect of sustaining those activities/linear resource system, Cost of dealing with contamination or invest in the repair/reuse process.
	Cultural	Not enough environmental awareness on repair and resue practices from local actors, Current social practices, Cultural diversity, Public unawareness of resource cycle, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions (local skills), Current linear resource flows,
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society,
Energy Recovery	Regulatory	Absence of a supportive framework for energy transition, Lack of regulations on off-grid energy production, Emerging models for looped resources.
	Economic	Economic viability, Not reaching a Circular Bussiness Model, Limited demand for looped resources, Linear resource system
	Cultural	Not enough environmental awareness, Current social practices, Cultural diversity, Public unawareness of resource cycle, Current lifestyles
	Technological	Technical limitations, Absence of operational conditions (local skills), Current linear resource flows
	Institutional	Absence of cross-sector alliance, Absence of institutional capability, Absence of autonomy amongst local stakeholder, Absence of commitment with civil society, Absence of trust in policymaker

Table 6.23. Main barriers to Circular Economy implementation Loop strategy Atlantis precinct

the assessment. These findings aim to address a summary for all of the actors of the collateral impacts each action could contribute valuable data for monitoring the transition towards a Circular City model in Atlantis precinct.

The impact indicators presented are across all stages in the implementation process (levers, actions and outcomes). The main aim that those indicators create awareness among the stakeholders of Atlantis precinct on the transition towards a Circular City model. Especially for policymakers, it is crucial to recognise what levers for developing Circular Action have been implemented effectively. The series of impact indicators presented are from qualitative to quantitative data are intended to have a holistic perspective of the process and present a valuable political instrument for monitoring and allocating funds towards achieving a Circular City model for Atlantis precinct.

The data of Atlantis impact indicators are reported from different stakeholders Industry, Third Sector, Government and Research agencies, the monitoring can be a challenge. As a consequence, the impact indicator data is provided in "silos", which is one of the main barriers that Circular City models face, and this research project aims to overcome. For instance, the economic indicators on Atlantis looping actions (industry related) are measured by the GreenCape. However, the information is not accessible to the public nor the relevant stakeholder in the precinct.
These current circumstances have hindered to introduced systemic solutions as there is not enough horizontal dialogue between the relevant stakeholders. Nevertheless, this will be fundamental for monitoring the progress of the process, to develop support and to distinguish the difficulties that may arise from it. Moreover, the findings on the Implementations' Barriers and impact indicators are crucial for the success of the Atlantis precinct Circular Actions Dynamics (Figure 6.50) as they present a useful governmental mechanism to monitoring these dynamics and allocating funds to Circular City models. Also, this feedback analysis highlighted potential complexities caused by adopting these actions or collateral effects.

REGENERATE		
STRATEGY		IMPLEMENTATION IMPACTS
Green Walls	Urban Fabric	Reduce CO2 emissions, Reduce air pollutants, Increase of leisure/recreational spaces in Green Space, Increase indegenous biodiversity areas.
	Demography	Improve health indicators on depression and alcoholism, Increase of social cohesion indicators, Improve learning performance, Increase security indicators, Decrease gangsterism
	Economic	Increase skills diversification, Increase Job creation
	Cultural	Increase of environmental awarness, Increase community participation, Increase the local know-how , Awarness on local resources, Increase sense of belonging reinforce identity.
Community urban farming	Urban Fabric	Increase land use for agriculture, Increase of leisure/educational/recreational spaces in Green Space, Increase of local food production
	Demography	Improve food security value chain, Improve of mental health indicators, Increase of social cohesion, Improve learning performance, Improve of indicators of healthy diets, Increase security indicators, Decrease gangsterism
	Economic	Increase circular business opportunity, Increase skills diversification, Increase Job creation.
	Cultural	Increase of environmental awarness, Promote heritage of local products/ recipes, Increased community participation, Increase sense of belonging reinforce identity.
Pollinator Biodiversity	Urban Fabric	Reduce CO2 emissions, Reduce air pollutants, Increase of leisure/ recreational spaces in Green Space, Increase of indegenous biodiversity,
	Demography	Improve health indicators on depression and alcoholism, Increase of social cohesion, Improve learning performance, Increase security, Decrease gangsterism
	Cultural	Increase of environmental awarness, Increase community participation, Increase sense of belonging/reinforce identity,
Water Recycling	Urban Fabric	Increase of blue infrastructure spaces, Increase quality of natural water ecosystems
	Demography	Increase basic services accesibility, Improve social cohesion, Improve learning performance
	Economic	Increase local water management and reduce expenditure, Increase skills diversification, Increase Job creation.
	Cultural	Increase of environmental awarness, Increased community participation on water saving practices.

Table 6.24 Implementation impacts Regenerate strategy Atlantis precinct

ADAPT		
STRATEGY		IMPLEMENTATION IMPACTS
Retrofiting infrastructure	Urban Fabric	Increase of energy optimization in neighborhood infrastrucre, Reduce CO2 emissions, Reduce air pollutants, Increase of biodiversity
	Demography	Improve of health standars, Increase of social cohesion.
	Economic	Optimize energetic consumtion expinditure, Savings of public expenditure, Skills diversification, Increase awarness on CE investment programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness on local resources, Increase of Green Public Procurement.
Reuse Infrastructure	Urban Fabric	Increase of spaces for green business, Increase regenerated areas, Improve infrastucture quality, Increase amount of infrastucture for civic commons purpose
	Demography	Increase of social cohesion, Improve learning performance, Improve of mental health.
	Economic	Increase economic circular SMEs, Skills diversification, Increase new entrepenuerial activities within the local community, Increase awarness on CE investmen programs, Increase number of local jobs.
	Cultural	Increase of environmental awarness, Increase sense of belonging reinforce identity, Awarness on local resources and services
Flexible Infrastructrue and Community	Urban Fabric	Increase of leisure/recreational spaces in Green Space, Increase of spaces for businesses and local activities, Increase regenerated areas, Improve infrastucture quality, Increase amount of infrastucture for civic commons purpose
	Demography	Increase of social cohesion, Improve learning performance, increase security, decrease gangsterism, Increase community participation, Improve health indicators on depression and alcoholism, Reduce youth exodus indicators
	Economic	Skills diversification, Increase new entrepenuerial activities within the local community, Increase awarness on CE investment programs, Increase number of local jobs, Diversification of the commercial and business enviroment.
	Cultural	Increase of environmental awarness, Increase sense of belonging reinforce identity, Increase promotion of heritage of local products/ recepies, Awarness on local resources, Increase sense of belonging reinforce identity.

Table 6.25 Implementation impacts Adapt Atlantis precinct

LOOP		
STRATEGY		IMPLEMENTATION IMPACTS
Recycle	Urban Fabric	Increase of spaces for green businesses and local activities, Increase amount of infrastucture for civic commons purpose
	Demography	Increase of social cohesion, Improve learning performance, Increase number of local skills, Improve health indicators on depression and alcoholism, Reduce youth exodus indicators.
	Economic	Reduction of waste going to landfill, High quantity of recycled material, Increase entrepenuerial activities within the local community, Increase CE investment programs, Increase local jobs, Increase local production, Increase circular SMEs, Increase diversification of the commercial and business enviroment.
	Cultural	Environmental awarness, Increase awarness on local resources and culture, Increase of Green Public procurement
Reuse	Urban Fabric	Increase of spaces for businesses and local activities, Increase amount of infrastucture for civic commons purpose
	Demography	Increase of social cohesion,Improve learning performance, Reduce youth exodus indicators
	Economic	Reduction of waste going to landfill, Increase of new entrepenuerial activities within the local community, Increase CE investment programs, Increase local jobs, Increase local production indicator, Increase circular SMEs .
	Cultural	Environmental awarness, Increase the local know-how, Awarness on local resources, Increase sense of belonging reinforce identity.
Energy Recovery	Urban Fabric	Increase of energy optimization in neighborhood infrastrucre, Reduce CO2 emissions
	Demography	Improve health indicators on depression and alcoholism, Increase security indicators, Decrease gangsterism
	Economic	Increase basic services accesibility (electricity and wifii), Optimization of local energy systems, savings of public expenditure, New circular SMEs, Increase of skills diversification, Increase on CE investment programs, Increase local jobs.
	Cultural	Environmental awarness, Awarness on local resources, Increase of Green Public procurement.

Table 6.26 Implementation impacts Loop strategy Atlantis precinct

6.10 Discussion Governance for a Circular City model for Atlantis System Dynamic

This section aims to discuss the results of the Systemic Design Framework for Circular Cities (Figure 4.4) undertaken to the Atlantis precinct case study. As displayed in the previous sections, the framework established ways in which Systemic Design diagnosed and assessed a more inclusive and cohesive policy design for a Circular City model for Atlantis precinct. The dynamics of the theoretical conceptualization were reflected on (Figure 6.50), which indicates the complexity of the precinct Circular Actions relationships. These findings demonstrate positive synergies are linking all three Circular Actions which support each other, to maximize the benefits. Nevertheless, this research examination also admits that further data is required to examine these dynamic interactions thoroughly.

SYSTEMIC IMPLEMENTATION & FORESIGHT

In order to discuss the complexity of the outcomes, The researcher synthesised Atlantis Circular City model (Figure 6.50). To comprehend the systemic implementation that such model will imply, on (Figure 6.51) is highlighted the status for each implementation (executed, planned, potential) based on information of tables (Table 6.18)(Table 6.19) (Table 6.20).

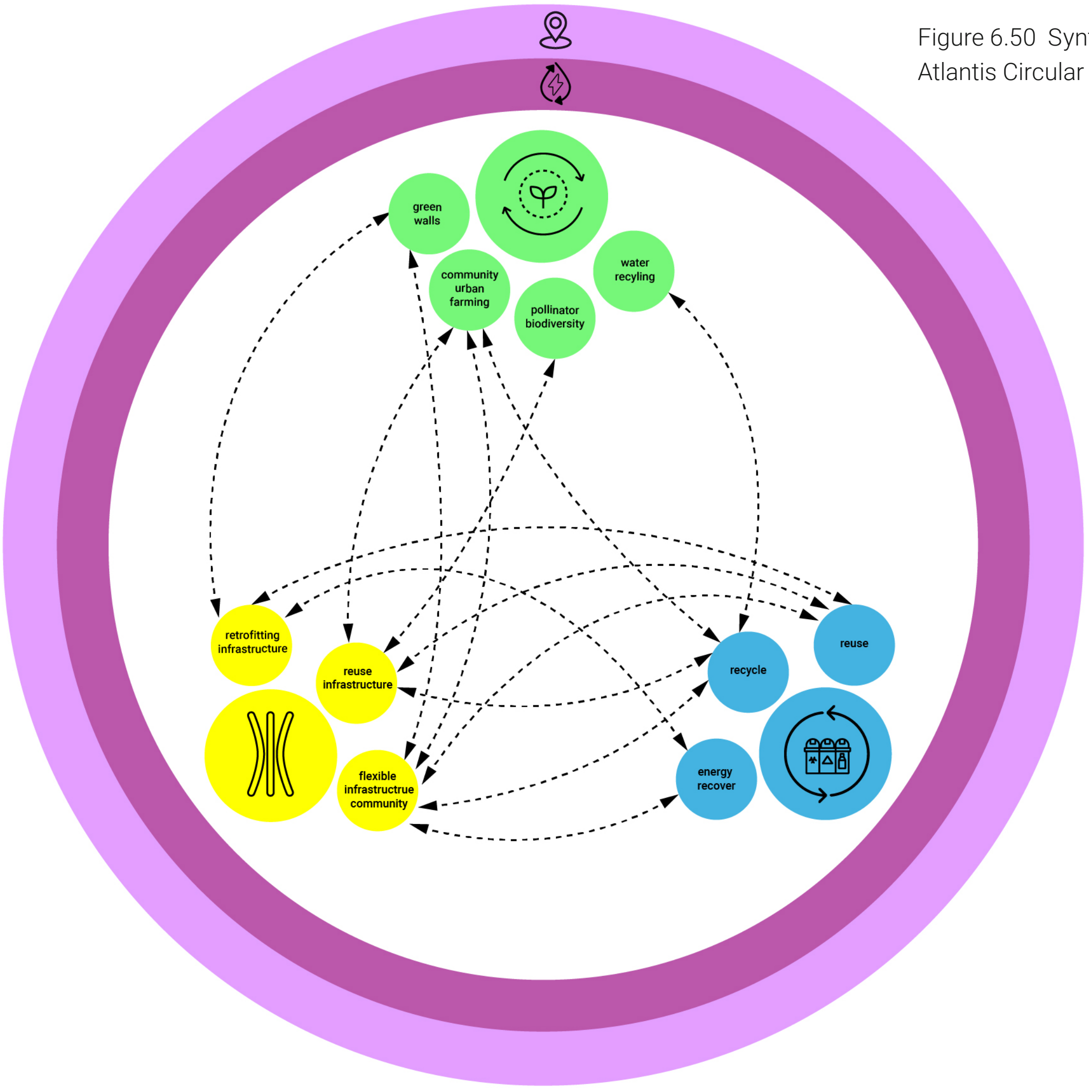


Figure 6.50 Synthesis Atlantis Circular City model

The (Figure 6.50) presents a prospect from the synergies among Circular Action. Furthermore, it indicates the combination of actions which may work together successfully on the Atlantis precinct. For instance, (Figure 6.50) presents Adapt and Loop as the actions with the most connections with other actions on the in the system. Nonetheless, in (Figure 6.51), it evidences that most of Adapt implementations are potential and very little has been executed, and Loop implementations are the most consolidated (Executed). A significant influence on that is the actions undertaken in the industrial area such as the Greentech SEZ which has increased a considerable number of programs and policies supporting Loop actions in the precinct (Table 6.3). Therefore, this action is the crucial lever to activate the new circular system for Atlantis precinct, as it will influence the other Circular Actions directly initiating the transition of the system. These outcomes should serve all stakeholders, but particularly CoCT City officials and policymakers to approach Loop actions as the key to Circular City model but also target funds and programs for Adapt and Regenerate actions that are considerably not executed in the precinct.

This Circular City model for the Atlantis precinct presents and strategy to transition to a new model system that creates/enhances local value within the territorial assets present on the Holistic Diagnosis. Precisely, because of the System Design approach applied, it was possible to identify and to define actions tailored to the needs and tools available in the Atlantis precinct. At the same time, distinguished the risks and wicked problems

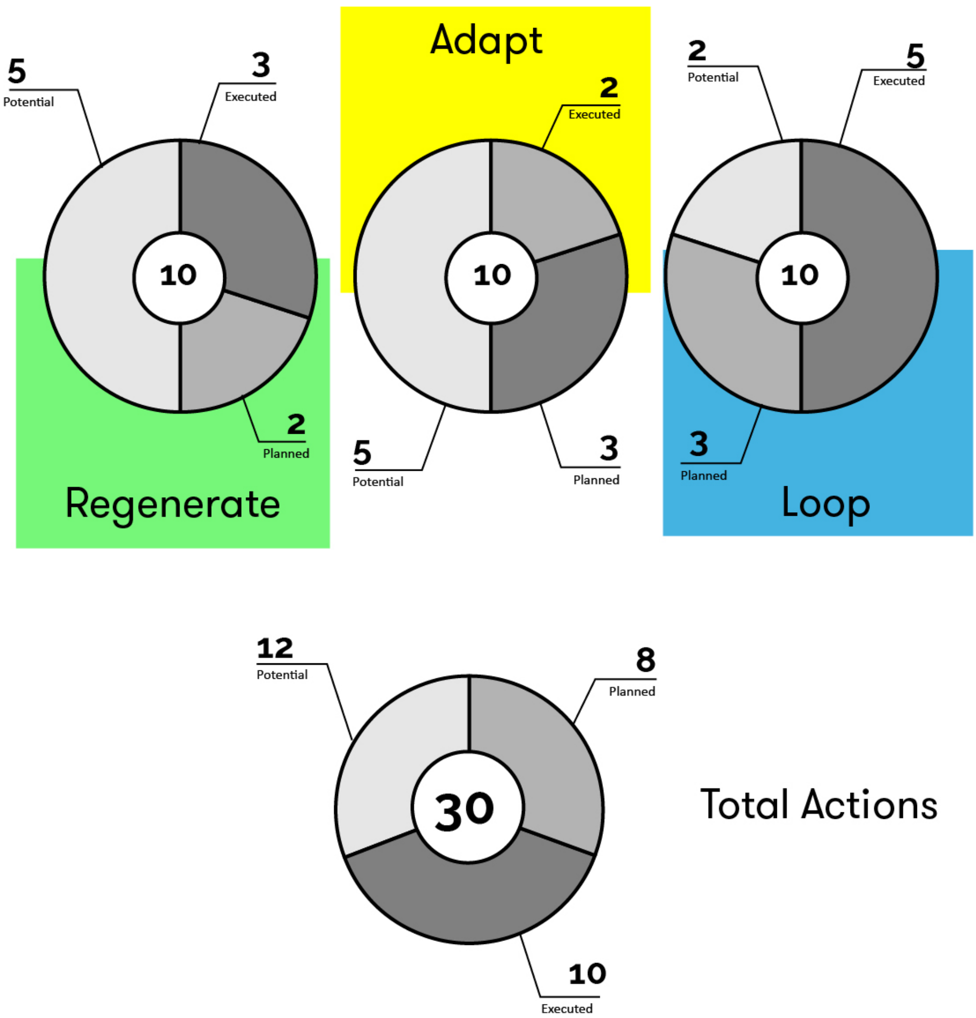


Figure 6.51 Implementation status for Circular Actions Atlantis

that could jeopardise a transition to circularity. For instance, an opportunity such as the Greentech SEZ if not embedded systematically could fall into another attempt of reindustrialisation with devastating social consequences.

With that in mind, framework results implied that for an implementation process of an Atlantis precinct Circular City model should entail a systemic approach to stakeholder engagement and activity development, that intends a policy change over time. However, the history of Atlantis has shown how the government has failed the Atlantis community on several occasions. On that view, the Greentech SEZ has supported community engagement and skills development programs that aim to generate a synergy between the community and the upcoming circular precinct. Such initiatives can undoubtedly boost the resulting framework proposed by this research examination.

Moreover, in this process was exposed the "actionable and proactive" mindset of the Systemic Design that combined with a foresight vision, could propose concrete outcomes in the short term (i.e. Looping action Solar Off-grid energy informal-settlements) while addressing broader actions in the long-term (i.e. Adap action potential Retrofitting industrial buildings). On that view, the resulting framework conceives an implementation impacts of the different Circular Actions have different timing for their execution. From that point of view, Systemic Design suggested a gradual introduction CE policy/strategy for Atlantis precinct developing within a short (executed), medium (planed) and long term (potential), where the short and medium ones are designed to support future implementations.

Indeed, the Atlantis Circular City model will have not only to address the social challenges as unemployment and alcoholism through a new circular market scenario but more importantly, it delivers a long-term value creation strategy to make the precinct resilient. To represent how Atlantis precinct Circular City model systemic implementation is constructed on a long-term horizon impact on CE policy planning process, it is worth to narrow an insight to the examined implementation impacts indicators (Table 6.24)(Table 6.25)(Table 6.26).

VALUE CREATION ON ATLANTIS PRECINCT

According to the presented results, through the Systemic Design approach was feasible to comprehend the nature of the wicked problems of Atlantis precinct, which are hampering its way into circularity. This research examination revealed that the interconnected nature of such critical drivers is embedded in the apartheid policies that conceived the precinct. Furthermore, apartheid wickedness had a long-term impact on how public policy has been implemented over the years. That effect has reflected in the traditional reindustrialisation programmed and policies, which have perpetuated the apartheid legacy and either promote local value.

Besides, the outcomes demonstrated that the wickedness Atlantis precinct is reinforced by a linear model of governance, which has enclosed the precinct socio-economic challenges into "silos", narrowing the understanding of the bigger picture by managing authorities, community, industry and research institutions. At the same time has kept the precinct isolated from the city and reinforcing it as a deprived ghetto. This bureaucratic model was particularly challenging through the data collection process as different local government institutions managed different data sources, or data collection in the precinct.

From that perspective, it was possible to comprehend the reason why the past government programs in reindustrialisation and urban development has never been appropriately articulated and it's because the traditional linear and analytical method of problem-solving. These current dynamics can hinder a transition to circularity in Atlantis precinct such as the Greentech SEZ, as there has never occurred a holistic engagement of a quadruple helix stakeholder dynamic.

So, to accomplish a transition of CE is required to disrupt governance silos in Atlantis precinct. Specifically, into the decision-making process of the Greentech SEZ whose, master plan and implementations are a not-to-be-missed opportunity. For that purpose, this research examination proposed a shift on the current policymaking/decision methods through the implementation Systemic Design approach.

The outcomes of this systemic evaluation for Atlantis case study undertaken withwith Systemic Design Framework for Circular Cities (Figure 4.4) introduced a more adaptive and collaborative policymaking framework, which involved all territorial assets from opportunities to challenges for local value creation and all current levers policies & projects that could support future CE strategies.

The Atlantis system assets visualised in section 6.4 brought into evidence many “sleeping assets”, not acknowledged previously by other regeneration or circular strategies currently present in Atlantis precinct. For instance, the mapping revealed how the indigenous biodiversity, public infrastructure and ancestral cultures have the opportunity to interact to generate more adapt/ regenerate strategies. This holistic overview revealed hidden assets that can create local value if enhanced, can be the key for circularity in Atlantis.

At the same time, the analysis of the Atlantis Policy framework (see section 6.3.1.2) expose what policies or grassroots programs have enhanced directly or indirectly circularity. On a macro perspective addressing the CE there the CoCT Resilience strategy (2019) which aims to coordinate actions towards a social, economic and environmental resilience in the city, influencing of course Atlantis. In a more localised perspective, the most narrowed strategies addressing CE are Greentech SEZ Atlantis and the material flow Atlantis database (WISP) which are mostly focused on the Industrial perspective. Nevertheless, it also underlined the lack of policy instruments to activate a circular process in the precinct and that most circular programs are coming from a top-down perspective, proving that circularity requires to connect from a bottom-up/ local value perspective.

In addition to this, the research process of the Atlantis Stakeholder identification (see section 6.3.1.3) presented the mapping of the “lead stakeholders” (ASEZ-CSN, GreenCape, WESGRO and CoCT) to articulate a quadruple helix that resiliently creates value over time. Still, the quadruple-helix established since the start of the Greentech SEZ, which facilitated the analysis and allowed the researcher to access their databases and discuss with them the framework process towards a Circular City model for Atlantis precinct.

Those drivers led the examination process into the exploration of Circular City public policy leverages rendered into CE actions presented in (Figure 6.50) Synthesis Atlantis Circular City model and (Figure 6.51) Implementation status for Circular Actions Atlantis. These outcomes introduced a new Circular City model system for Atlantis that through anticipatory scenarios, could bring more future-oriented and sustainable-oriented policy actions to enhance local value creation. For instance, the outcome framework can influence the upcoming masterplan vision of the Greentech SEZ towards a more local value creation perspective rather than only focus only overseas investment from the arriving companies.

With that in mind, the research results acknowledge that such system transitions in Atlantis towards circularity will disrupt the established investments, jobs, behaviours, knowledge and values from the apartheid era. That means that from the systemic conceptualisation of local value, establishing a different business culture that can promote more resilient jobs and shifting the socio-economic crisis.

Therefore, the proposed framework of this examination aims to present evidence on policy design instruments which can unlock the potential local value from natural capital, local know-how or ancestral cultures, which are more likely to be consistent and cohesive with long-term environmental goals within the Atlantis precinct.

Besides, through the precinct system visualisation (see section 6.4) and (Figure 6.50) Atlantis Circular City model, it promoted a horizontal conversation among quadruple helix key stakeholders to build strong synergies through a broader vision of what circularity can mean to the Atlantis precinct. The model provides a common understanding of complex problems and sharing responsibilities to cope with change.

A SYSTEMIC DESIGNER ROLE

On the results of this Case study research, the Systemic Design has proved the means and knowledge to operate this wicked scenario on a global south perspective aiming to maximise the value of government, in this case, the decision-making process of CoCT civil servants. To enrich Bason's (2018) exploration of the designer's roles in the policy design process, the framework here developed supported the researcher/designer to act as a mediator between the bottom-up and top-down government bodies. The designer combined a skillset to anticipate future situations and create innovative results developing new approaches to complexity (Celaschi et al., 2013).

In this examination was emphasised the supportive role of the designer as an 'agent of change' (Greene, 2013), specially in the co-design sessions and roundtables. For that aim, the researcher/designer entailed advocating on activating Atlantis local assets, among all local stakeholders directly involved, spreading complexity over the various nodes in the system instead of seeking a single, large, complex and unitary top-down solution which has been a constant governance model in Atlantis.

On that view, the researcher here acted as mediator between the bottom-up Atlantis community (cultural leaders and third sector) and top-down CoCT, WESGRO, GreenCape, developing a decision-making mechanism that supports local assets and social innovations to co-creating circular strategies that can be sustained and sized up within the synergy and cooperation of the top-down institutions.

The Systemic Design Framework for Circular Cities (Figure 4.4) precincts here developed provided a holistic understanding of the Atlantis precinct towards co-designing situated circular strategies for decision-making. The study also explored through the systemic design tools for CE policy design that can address the wickedness of Atlantis precinct and highlighted; A decision-making instrument that can develop active support cooperation among local actors and can support the ongoing master plan process such the Greentech SEZ.

As a result, during this Atlantis Case Study, the value of the systemic designer lied in interweaving a systemic transition towards a Circular City model unveiling ways to build local value from a community that in the vision of many is hopeless and disastrous apartheid legacy.

6.11 Reflections and following work

This examination contributed to filling a gap in the knowledge of a situated and embedded approach to systemic design for CE policy design, which – for this research – was developed concerning post-industrial precincts. This Atlantis precinct Case Study allowed bridging from the theoretical proposition of Systemic Design Framework for Circular Cities (envisioned in the Scoping Study) to the practices co-designing situated circular strategies for decision-making. The following paragraphs summarise the key conclusions of this study, concerning both the Circular City model for Atlantis precinct and the Systemic Design process.

6.11.1 Key Conclusions Atlantis precicnt

- The Systemic Design Framework for Circular Cities (Figure 4.4) precincts undertaken provided a profound holistic comprehension of the Atlantis precinct, allowing a diagnosis of all territorial as a complex web of assets from the surrounding indigenous vegetation capital to the predominant legacy of the apartheid industrial voids precinct which proved to have the potential to create value and foster the transition towards a Circular City model. The results of the desk research and field research which underlined the Atlantis wicked problems complexity which comes from mainly from its post-apartheid deindustrialisation process promoted by years of a linear economic and governance model. On that view, the examination outcomes underlined the complexity of designing a Circular City model that can overcome the Atlantis wicked barriers to the CE, which mostly reside in the apartheid legacy.

- To overcome the critical socio-economic degradation that was brought by the decline of this industrial precinct, the proposed Circular City model for Atlantis presents a systems transition strategy towards a new system model that creates/enhances local value within the territorial assets present on the Holistic

Diagnosis. Additionally, it increases more and resilient local livelihoods that do not depend entirely on external factors (i.e. changes on the global market) or government policies and that are resilient over time. Therefore, such a model for value creation aims to enhance the life quality, in the long run, empowering the precincts identity local culture and attracting opportunities for the current and upcoming population.

- The Holistic Diagnosis performed a central role in scoping the precinct context, collecting qualitative and quantitative data and visualising the precinct, from a broader lens within the collection of various feedbacks from all stakeholders groups; civil servants (CoCT), industry (WESGRO, and community (Atlantis SEZ Community Stakeholder Network) and Research (GreenCape). This research examination revealed that the interconnected nature of Atlantis wicked problems which are embedded in the apartheid policies that conceived the industrial precinct. Such wickedness has been reinforced over time by a linear model of governance, which has enclosed the precinct socio-economic challenges into "silos", narrowing the understanding of the bigger picture by managing authorities, community, industry and research institutions. At the same time has kept the precinct isolated from the city and reinforcing it as a deprived ghetto. To address a better understanding of such challenge, the Holistic Diagnosis enabled the visualisation of opportunities and challenges for value creation, making possible to identify and to define actions tailored to the needs and tools available in the Atlantis precinct.

- The outlined strategy of the study was the Atlantis Circular City model (Figure 6.50). The systemic implementation that such model will suggest the Loop Circular Action as the crucial lever to activate the new circular system for Atlantis precinct, this is due to the strong influence of the Greentech SEZ. Therefore, it is expected that Loop actions will influence the other Circular Actions directly activating the transition of the system. Hence, the model approaches Loop actions as the key to a Circular City model that means CoCT should target more funds and programs to Adapt and Regenerate actions that are considerably not executed in the precinct. These outcomes should serve the networks of stakeholders who could sustain the implementation of the Atlantis Circular City model to reach horizontal dialogue and collaboration between bottom-up initiatives and top-down support.

- The research underlined the main CE barriers that the proposed Atlantis Circular City model which cut across resources and actions in the precinct: absence of trust in policymakers, scarce institutional support, absence of a supportive regulatory framework, dependence on the private expense, lack of operational conditions (local skills) and current cultural values. The identification of such barriers can serve as a lever to maximise the impact of the Circular City model and reduce the effects of the enlisted obstacles.

- This framework results implied that for an implementation process of an Atlantis precinct Circular City model should entail a systemic approach to stakeholder engagement and activity development, that intends to influence the upcoming Atlantis precinct masterplan. The Systemic Design Framework for Circular Cities intended to inform a policy design process within Atlantis precinct on the lens of the Circular City model. At policy-making level, these results will aim to influence local policies on Atlantis precinct, fostering better governance and disseminate innovative solutions towards a CE at multiple levels such as:

a. *On the technical level,* through the Circular Actions implementations presented, based on the local energy and material flow (urban metabolism networks) through which will result in the creation or redesign of local, circular supply chains. On the case of Atlantis, the Greentech SEZ is attracting the technicalities required for Loop actions to enhance the industrial metabolic network. However, this requires a vast development of local skills to implement circular strategies and create local value. On that view, the Greentech SEZ has supported community engagement and skills development programs that aim to generate a synergy between the community and the upcoming circular precinct.

b. *On the social level,* due to the Socio-economic degradation of the precinct, it is required more support to the Third sector organisations network who can enable more citizen-based ownership of local resources on civic commons or industrial voids/infrastructures through co-designing, co-creating, and co-implementing of new protocols for the integration of CE strategies. For example, the integration of informal vendors or vulnerable population on circular business models.

c. *On the economic level,* through systemic approaches boosting circular business models for products and services on all Circular Actions, highlighting market opportunities and public-private partnership models for circular productive activities (the Greentech SEZ is already identifying such partnerships). To overcome the systemic effects of apartheid (subsequent de-industrialisation) and reactivate economic growth the suggested implementations Atlantis precinct Circular City model intends to propose a value creation economic model for the precinct-based on local resources and skills, to generate a more resilient local economy. THE model delivered an economic system that is more coherent and tailored to the community cultural values supporting a transition into a productive and stimulating place to live and work.

d. *At a cultural level,* the proposed circular strategies to be resilient must meet simultaneously today's cultural and economic interests enhancing the precincts identity. On that view, to overcome the apartheid stigma of the deprived ghetto, the Atlantis precinct requires to create a new identity based on value creation, that promotes territorial awareness concerning all local resources and sustainable development. Therefore, these sense of appropriation on the Atlantis Circular City model must include the ancestral cultures (Khoisan- Griqua - Xhosa) to conceive CE strategies enrooted in the community. Indeed, the Atlantis Circular City model will have not only to address the cultural system challenges as unemployment and alcoholism through a new circular market scenario but more importantly, it delivers a long-term value creation strategy to make the precinct resilient.

- The systemic implementation process of the Atlantis precinct Circular City Model suggested gradual introduction CE policies/strategy for Atlantis precinct developing within a short, medium and long term. The research presented that the Loop actions been the most executed are likely to display short-term results which can support middle term (planned) and future (potential) implementations. Therefore, the study delivered a decision making an instrument that can address the wickedness of Atlantis precinct within a long-term resilient perspective. On an immediate effect, such an instrument can actively support cooperation among local actors on the ongoing master plan process such the Greentech SEZ.

- On a value creation point of perspective, the localise Circular Action demonstrates to be one of the pillars of Atlantis according to the systemic principles of the proposed, as it embraces all Circular Actions on the find local synergies establishing local symbiotic capital. In the case of Atlantis precinct, this meant creating new partnerships between the natural capital, the local heritage (Khoisan- Griqua - Xhosa), local/ upcoming industries and the city government, ensuring a resilient value creation dynamic.

6.11.2 Key Conclusions Systemic Design

- The researcher tested a conceptual framework of the Systemic Design Framework for Circular Cities (Figure 4.4), applied to the post-industrial precinct of Atlantis. In this view, the framework framed a top-down/bottom-up approach including a quadruple helix dynamic with all stakeholders groups; civil servants (CoCT), industry (WESGRO), and community (Atlantis SEZ Community Stakeholder Network) and Research (GreenCape). To co-designing the

Atlantis Circular City model strategies that increased awareness on CE local resources, opportunities, and challenges and resilience of the precinct.

- In this case study, the Systemic Design proved to a methodology that can provide the macro and micro dimensions that the CE implies. In particular, for in a challenging scenario as Atlantis, where plans at a macro scale (Greentech SEZ) are predominant, the proposed framework presented the assets to involve circularity as an enabler of the precinct's identity. Therefore, proving the necessity for systemic thinking when addressing a CE and an awareness from a micro-macro dimension. On that view, a Circular City panorama requires a foresight horizons perspective to enable long-term decision-making. The results presented an adaptive governance Circular City model that confirms how the systemic design approach can deliver resilience for CE governance.

- The Atlantis Holistic Diagnosis research synthesis and visualisation pave an efficient way to interpret current and new circular strategies. The approach developed territorial thinking immersion on Atlantis precinct among the quadruple helix stakeholders establishing a standard comprehension of the current complexity of the system from the urban fabric, demography, economic, cultural and policy perspective.

- The stakeholder engagement had success because through the examination process; the stakeholders were stimulated to think holistically and to overcome divisions between different sectors and roles, pursuing shared objectives for the precinct. The researcher had the opportunity to develop those engagements during SEZ Greentech Master plan sessions (including all quadruple helix stakeholders), to influence the adoption of the Circular City model on the future developments of the precinct. On that scenario, the researcher/designer proved its moderator capability and skillset to drive innovation processes.

- Through the Holistic Diagnosis visualisation of opportunities for value creation supported an active collaboration between the quadruple helix stakeholders, and boosting locally based value chains, delivering innovative strategies on the micro/macro scale and the short/long term. The study highlighted how the systemic designer's mindset and methodology could be supportive strategic CE decision making, developed in a collaborative and multi-stakeholder process. Furthermore, Systemic Design proved to enhance social learning and capacity building; they build trust and mediate power through cross-sector collaboration.

- This study implemented a collaborative policy design processes among Atlantis stakeholders which displayed the required synergies and current challenges to acknowledge to move towards a Circular City model which implies value creation in a long-term horizon.

- The applied framework on Atlantis precinct implied Systemic perspectives and participatory methodologies that trigger innovative processes of sharing knowledge and experiences among different stakeholder and can build innovation in the public sector. In particular, the case of Atlantis different levels of governance where involved (city, provincial and national government), it was an opportunity to create synergies between and the bottom-up actors. Applying a systemic perspective into those strategies means to favour adaptive governance, whose outcomes are iterative and autopoietic, creating endurable public value.

- Ultimately, the roundtable discussion on the system design phase served as a way to break stereotypes with traditional participatory processes. Therefore a new decision-making dynamic began within the local stakeholders based on a holistic perspective from the precinct. On that view, the stakeholder group can take more responsibility for co-creating a Circular City model for the Atlantis precinct, based on the promotion of the local assets and levers. In this view, instead of presenting fixed systemic design outcomes, an on-going process of transformation was activated.

- Finally, the Circular City Model for Atlantis exemplifies disruptive and transformative dynamics, as a practical methodology to enhance the CE transition in a global south context. The Systemic Design Framework supported these results for Circular Cities in Post-industrial precincts, which brought a systemic policy approach for an effective CE policy-making, incorporating different policy interventions to boost the cooperation in Quadruple Helix—in this way, creating a doorway where designers, managing authorities, and citizenship can effectively co-develop new policy opportunities.

6.11.3 Limitations of the Study

The researcher had previously executed research within the City of Cape Town, and due to this experience, she was able to reach out to Atlantis precinct relevant managing authorities from the GreenCape and CoCT. As the GreenCape agency is managing the upcoming Atlantis Greentech SEZ, they consider this examination was relevant to the current master plan process Atlantis is undergoing. On that view, they accepted to collaborate for this examination and were interested in integrating some of the outcomes.

The GreenCape provided access to some of the city database and was the main intermediary to reach the different city officials. Yet, the required data was not centralised, and it was necessary with the support of the GreenCape or sent a request of different databases to different city agencies. In that phase, the researcher faced the problem of different city agencies in "silos", as some of them wanted to cooperate with others not. Also, this is reflected in the level of updated data, and certainly, this affected the research outcomes. In the end, it was possible to gather most of the data, thanks to the direct relationship with the city officials otherwise was impossible to carry such research. This limitation proved that so many of the decisions are "behind closed doors" if city agencies are unable to share among them vital data. Also, in the particular case of Atlantis in many city maps is not included due to its distant location, this hampered the data collection as some city agencies do not gather data on Atlantis precinct.

The researcher requested the support of the WISP team for most of the economic data, as they have a database on the census of all Atlantis industry. Moreover, this database has extensive information on the industrial material flow database where they had registered the material inputs and industrial waste. Still, they only provide the typologies, not the total amount of industrial waste; this impacted the results. The WISP team found that the aim of the research could assist them to reach more potential local symbiosis among Atlantis industries and with the local community. In general, there is a low interaction between the Atlantis industrial area and the local community.

For this examination, the collaboration with the third sector representative was possible through the GreenCape that organised encounters between the researcher and Atlantis SEZ Community Stakeholder Network. Such encounters were vital to understanding the broad spectrum of the Atlantis community. However, the databases on the precinct community executed projects in the community were provided by CoCT officials. The researcher attended many of their community events in several field visits; one of the main difficulties was the language barrier as the predominant language is Afrikaans.

In particular, the roundtable co-design process suggested the repercussions and limits of the collaborative processes that faced a Systemic Design approach in such a context. In the context of Atlantis precinct, organising such meetings can be challenging as the participants of the community tend to be sceptical, as explained in the introduction participatory process have been criticised over the years. In such environments can be evident the tensions between the community and the government, which makes more challenging to create a neutral ground for discussion between the stakeholders. The apartheid historical past is so embedded in Atlantis that the Systemic Design participatory approach in some circumstances of the examination faced scepticism from some local actors. The reason for this is the resentment towards the government. Also, is because designers are rare to participate in such a process, probably this was the first time on the precinct.

In addition to that, the cultural information mostly came from informal conversations on-site visits to representatives of Atlantis First Indigenous peoples community, Khoisan renaissance cultural awareness and Griqua Royal house, as there is no written source on Atlantis cultural heritage. In general, on the framework development, it was visible that the bottom-up outcomes are not present enough in the decision making of the City.

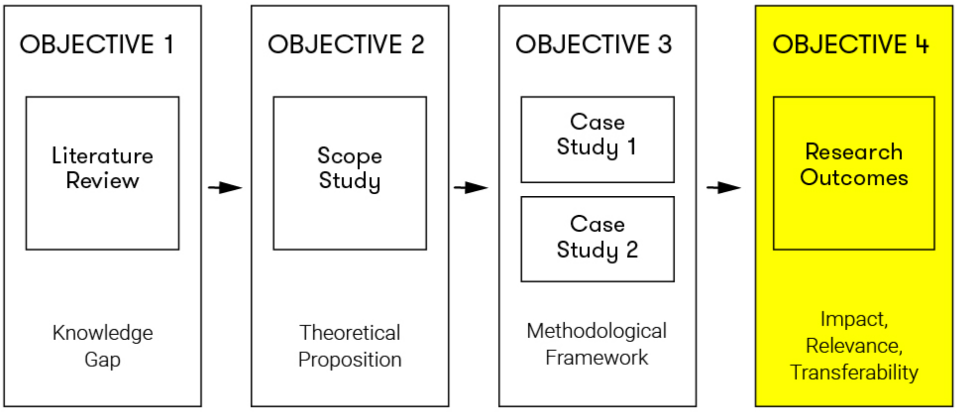
6.11.4 Next Steps

The contribution of this study lies within the activation of the Atlantis to transition towards a Circular City model. Nevertheless, much more research is required to be done as examine new dynamics between actions and experiment those already identified. Additionally, given that the policy implementation to foster the process towards a Circular City model implies time, resources and contextual factors, which go beyond the scope of this doctoral research, assessing the impact of the proposed model is left open for future work.
On the theoretical contribution of this research to the systemic design field, the applied framework developed in an African city (Global South) will be reviewed and asses with outcomes of Chapter 5 on a European city (Global North). On that view Chapter 7, will assess how this investigation aimed at assessing the impact, relevance and transferability of the proposed circular framework in other cities, as well as at highlighting the limitations of the research and presenting recommendations for future work.

Lastly, the GreenCape, WESGRO and CoCT officials want to keep the discussion forward on the results of this research. This research provided critical feedback to the implementation process of the Greentech SEZ, which aims to turn Atlantis in a circular precinct overall.

Chapter 7

Research outcome



This Chapter combines and presents the critical findings from the research and illustrates how they contribute to the current body of knowledge outlined in the literature review. The research outcomes of this examination addressed research objective 4, 'to evaluate the potential impact and relevance of this research project's contribution.

7.1 Introduction

The research explored how a Systemic Design approach can support a Policy Design process on Circular Economy (CE) towards a Circular City model in post-industrial precincts. This thesis argues that CE policymaking wicked scenarios are often reinforced by a linear model of governance, which encloses problems into "silos" and limits the understanding of the complex nature of such systemic problems. Therefore, to achieve a transition of CE in cities, it is needed a radical shift towards a more adaptive and collaborative policy framework. On that perspective, city governments approach CE policy instruments that enhance local value which is cohesive with long-term environmental goals of a Circular City.

In order to overcome the current governance challenges towards a Circular City model in post-industrial precincts, this thesis proposes an a Systemic Design (SD) as a co-design methodology to address CE policy cycle, delivering a holistic territorial diagnosis for local value creation strategies that respond to the system challenges, which means in the scope of this investigation to create resilient Circular City models for post-industrial precincts.

With this in mind, a systemic transition into the Circular City model requires a transdisciplinary approach that involves a quadruple helix and designers as mediators to co-create CE strategies within a bottom-up and top-down that fits each scenario. The SD approach delivers a holistic overview of complex post-industrial scenarios which can activate a Circular City model that arises from the appraisal of the resources offered by post-industrial precincts.

As an outcome, this thesis proposes a Systemic Design Framework for Circular Cities (Figure 4.4), which can implement in a policy cycle a more inclusive and cohesive policy design for a Circular City model. The framework aimed to create through the lens of the SD approach diagnoses and asses to co-design CE strategies in precincts that can coexist to address activating new mechanisms for value creation towards a Circular City model. In order to be applied to the case studies selected for this research: Mirafiori South and Atlantis precinct.

Both precincts regard their post-industrial legacy as a pillar for to generate a Circular City model yet, the nature of both scenarios (Europe/Africa) is radically different which brought to the outcomes a broader and different understanding on how to activate decision-making process to transition into a Circular City model.

The case study application aimed to oversee the strengths and challenges of the proposed framework implementation through examining four levels of innovation: technical, social, economic and cultural, which will be approached in the following section. Moreover, this thesis addressed the issue of 'value creation' CE policymaking process (or policy cycle Table 2.5) by proposing that Circular City model system through anticipatory scenarios, could bring more future-oriented and sustainable-oriented policy actions to enhance local value creation. Also, examination findings have shown that SD provides knowledge to navigate this wicked scenarios aiming to maximise the value of government tackling and be supportive in CE policy foresight practices and strategic decision making in cities.

Over the past chapters, this examination has presented a design process research on circular economy policy implementations. Moreover, the outcomes provide how the role of the systemic designer can influence the design for CE policymaking providing a space for design practices to be involved in the construction of policies addressing designers' skills and knowledge towards higher goals in this case a Circular City model.

7.2 The Expansion of the Field of Systemic Design for Circular Cities governance

The vast transformation the CE will bring in the next years indeed will transform the global panorama, designing new geographies from an economical-social-environmental viewpoint, generating synergies between economic and environmental goals. On that perspective, the CE is amongst the most pressing challenges that today's cities are facing in particular for those with post-industrial legacy.

Through the outcomes of this research processs it is undeniable that the advantages that a CE transition offers; however, it is necessary a systemic policy approach that ensures a cohesive transition based on value creation and prevents the unknown economical-social effects this transition might bring. In particular, during the study was possible to overview the governance wickedness on post-industrial precincts to re-activating them relies on a linear decision-making problem in "silos" during a policy cycle setting out various city policies across the years have fixated on fixing the problem with reactive measures such as reindustrialisation or traditional regeneration programs. This CE barrier is one of the most important ones identified across this examination (Table 2.3).

To overcome the systemic effects of deindustrialisation, post-industrial precincts as the representation of a failed economic system in cities present as an opportunity to apply from a governance perspective the Circular City model. For this purpose, to understand what implies the implementation of a Circular City model and its governance, it is required a holistic examination of their urban fabric, metabolism, economics, demography, local culture and current policy frameworks (Bulkeley et al., 2011; Monstadt, 2007) for which this research investigation poised the SD approach for policymaking cycles (Table 2.6).

For the purpose of this examination, the literature review outcomes in (Chapter 2) narrow the study introducing an SD as a methodology to approach CE policy design as it delivers a holistic territorial diagnosis and value creation strategies that respond to the system challenges and generate innovative governance models and policy cycles for the CE.

In order to determine in which ways the SD can implement a more inclusive and cohesive policy design for a Circular City model in post-industrial precincts, the examination developed as one of the main outcomes a Systemic Design Framework for Circular Cities (Figure 4.4). This research result was based on the SD method described in Chapter 2-3 and the scoping study on Circular City framework (Chapter 4). The framework overtakes the lens of the Systemic Design to diagnoses and asses post-industrial precincts into Circular City models.

These research outcome complements the Systemic Design methodology as it adds the scope of Circular City model elements narrowing towards a CE perspective for post-industrial precincts. Moreover, the framework delivered a co-design approach to tailor CE strategies that can coexist to deliver social and economic welfare and activate new mechanisms for value creation in post-industrial areas. The further examination of this framework was through the cases study of Mirafiori South and Atlantis precinct which allowed bridging from the theoretical proposition of Systemic Design Framework for Circular Cities to tangible practices co-designing situated circular strategies for decision-making (Chapter 5 and 6).

These new frameworks delivered the following innovation elements to support a CE Policy Design process (policy cycles) towards a Circular City model in post-industrial precincts on each phase:

1. *Holistic Diagnosis*: The framework provided a tailored approach to achieve a more comprehensive system perspective of the post-industrial precincts information. To produce a wider visualisation of the system, it required a methodological data collection of the quantitative to the qualitative data within the tailored tools; Data categories (Figure 3.5), Policy Framework Analysis (Figure 3.6) and Stakeholder identification (Figure 3.7). Those elements provide visualisation of all the components that define the post-industrial precinct from the total amount of resources, material flow and to the stakeholders, the system implies. The analysis of the system required a quadruple helix approach that involved designers, governments, community, industry and research institutions to co-create CE strategies including bottom-up and top-down that fit those precincts. On terms of the policy cycle, it influenced the step 1. Agenda Setting as it provides an overview of each post-industrial precinct assets to settle a CE model.

2. *Definition of problems & leverages*: This phase provided a critical overview of the local precinct assets that serve as potential levers and activate a systemic transition towards circularity and value creation. For this framework on post-industrial precincts, such Local Assets Potential Levers

were defined in: Opportunities as value creation and Challenges as value creation. On this phase, every local lever presented on the Holistic Diagnosis was addressed to support a system transition towards a Circular City model. Also, it included a critical analysis of each precinct Policy Framework that identified (Bottom-up/Top-down) policies & projects that could support future CE strategies understanding their effectiveness or their gaps/failures. For the policy cycle (Table 2.6) this stage fully allows defining an Agenda setting (step 1) for the CE based on the local assets (opportunities and challenges) that allow value creation strategies.

3. *Design the system:* The framework provided a combination of the systems perspective and the scope of a Circular City model to establish co-design practices for post-industrial precincts. The delivered conceptualisation re-framed the approached Circular Actions proposed by Williams (2019) within the Systemic Design principles. This examination shifts the association approach between the actions in order to design the system (Circular City models in post-industrial precincts) on an autopoietic systems perspective (Figure 4.6). In particular, the most relevant outcome is the localise action role which wraps the entire Circular City framework as it stands by the core principle of Systemic Design approach towards creating local value and unlocking circularity. Furthermore, localise and optimisations actions were mandatory indicators for all CE strategies to happen. According to that, the framework approached firstly identifying the local resources within Main Circular Actions (Regenerate, Adapt and Loop) and subsequently the supporting actions (Share and Substitution). To redesign the current system based on relationships between processes and actors to obtain zero emissions and create local value. In order to address the 'Local Assets Potential Levers' outlined in the previous step, the researcher adopted a roundtable co-design approach (Parker & Parker's, 2007) with the selected stakeholders (the quadruple helix) to identify and co-create of the circular actions. The co-design sessions aimed to generate locally situated knowledge that delivers a top-down/bottom-up approaches, conceiving a situation where all stakeholders were active participants of a value co-creation process. This co-design format showcased the framework progress to a broader audience of stakeholders and captured a more overall panorama of the potential implementation of the Circular City model. In particular, the roundtable co-design process suggested the repercussions and limits of the collaborative processes that faced a Systemic Design approach in such a context, as design can be a relatively new practice in the field of CE for policymaking. Furthermore, this step provided essential input for the policy cycle (Table 2.6) Policy Formulation step as it delivered a comprehensive review of the precinct assets to serve the circular precinct strategies.

4. *Outcomes Evaluation:* This phase of the examination classified the outcomes of the previous steps into concrete CE strategies narrowed on main Circular Actions. The strategies were exemplified for each action, as shown in Figure 4.6. This assessment approached these circular strategies on the lens on their local levers identify previously. The purpose of this examination was to understand what actions could have more local levers involved to be activated. As indicated in Table 2.6 policy cycle this influence the Policy Adoption delivering an overview of what actions could activate al Circular City model dynamics .

5. *Implementation:* The framework after identifying the CE strategies the examination was established concrete implementations for each strategy to understand the proposed system dynamics (Figure 4.7) and a 'Time-Based Design' approach. The identified implementations within a short (executed), mid (planed) and long (potential) term perspective. Therefore the purpose of the analysis was to present a gradual transition that should create local value and to overview which Circular Actions are related to (cross-cutting actions). As a result, generating a systemic dynamic that conceptualised gradual implementation of a Circular City model in a post-industrial precinct. On regards the influence on the policy cycle (Table 2.6) implementation step this outcomes can support the program development to execute short and long term circular policy plans.

6. *Results analysis and feedback:* On the final phase, the framework presented an assessment of the Circular Actions (or new circular system) for each post-industrial precinct case study. For this purpose, the framework proposed they analysis through the lens of the Circular Economy Barriers (Table 2.3) and impact indicators (Table 4.5). Both filters can present a beneficial governmental mechanism for monitoring progress and allocating funds to the presented Circular City models. Besides, this feedback analysis could inform potential obstacles generated by adopting these actions or collateral effects. Therefore, guaranteeing continuous development towards an autopoietic post-industrial precinct the ultimate proof to know a territory has transitioned to a Circular City model. On regards the last step of the policy cycle the SD supports it through an assessment of the implemented system from an autopoietic point of that intends to measure the resilience level (economic, environmental and sociotechnical) of the circular city policy strategy.

The applied framework in both case studies, delivered tool for governance for the CE innovation in public procurement and policy cycle. Firstly, the holistic approach provided by the framework also allowed visualising each precinct's main barriers to wicked problems translated into the policy gaps. The outcomes presented a methodology that can trigger innovative processes on CE policy design process, which implies sharing knowledge and experiences among a quadruple helix building an innovative CE governance in the public sector. The framework considered that such collaborative policy design processes were essential towards value creation in a long-term horizon: they enhance capacity building, they build trust, and mediate the power through cross-sector collaboration. Moreover, the systemic design process applied to the Circular City model means to favour adaptive governance, whose outcomes are iterative and autopoietic, creating endurable public value. Still, much more research requires to be done to examine different dynamics between actions and test those already Circular City models identified; this framework as it has could be translated into other post-industrial contexts anc continue evolving.

7.3 Situating a Circular City model within a post-industrial precincts reality

The presented case study precincts are significant examples of a city-factory characterised by a relentless process of physical, economic and social degradation. Therefore both regard post-industrial legacy as a pillar for to generate a Circular City model. However, the nature of both scenarios Global North and Global South is entirely different. On the one hand, Mirafiori South precinct was considered to be the heart of the Fordist model of automotive mass production, the history of Italy. On the contrary, Atlantis precinct comes from the narrative of segregation conceived as an industrial township was considered the heart of the industrial cluster model for mass production in Southern Africa.

The framework implementation brought broader and different outcomes of how a Circular City model can be conceived in the global North and South. On that view, to evaluate the overall framework results is key to comprehend the difference and the differences and similarities on how to activate a decision-making process and CE strategies to transition into a Circular City model. The following paragraphs summarise the examination on situating a Circular City model within a post-industrial precincts reality concerning both the Circular City model and the Systemic Design process.

Overall the Systemic Design Framework for Circular Cities in Post-industrial precincts undertaken provided a profound holistic comprehension of both precincts, allowing an appropriate diagnosis of all territorial as a complex web of assets that can create value in the transition towards a Circular City model. The results of the desk research and field research highlight the complexity of designing a Circular City model on each precinct. For instance, both post-industrial scenarios deal with a segregation factor wich in the global north have created a degradation of the working class into poverty, whereas in the global south has enhanced a colonial legacy and poverty. On that perspective framework allowed to understand the different natures of the CE wicked barriers and overcome them with tailored systemic strategies for each context.

With that in mind, to identify the territorial assets the Holistic Diagnosis performed a central role in scoping the precinct context, collecting qualitative and quantitative data and visualising the precinct, from a broader lens within the collection of various feedbacks from all stakeholders groups (a quadruple helix approach). However, the nature of each the stakeholder group was different, which allow experimenting the framework in different levels of governance. For instance, the nature of the stakeholder group at Mirafiori South (Table 5.4) had one level of governance involved at a city level a high involvement of the education sector third sector organisations and limited participation of the industrial sector. The examination unveiled a wider spectrum of SMEs that are enrooted in the precinct but not considered or "unnoticed" actors who can have a game-changer role in the path towards circularity. On the other hand, the Atlantis stakeholder (Table 6.4) nature had different levels of governance involved as the area is part of national interest development (GreenTech SEZ). Therefore, there where involved agencies at the city, a provincial and national level representing a government, industry and R&D meaning that the stakeholder spectrum was broader and could affect the amount of participation of the community.

Based on each stakeholder group nature, the framework revealed that the interconnected nature of CE wicked problems which are embedded in how each precinct was conceived. Such wickedness has been reinforced over time by linear governance and economic model which is present in both cases, enclosing the precinct's socio-economic challenges into "silos" and ruling the area by a dominant top-down policy system and a little understanding of the systemic issues of the territory. To address a better understanding of such wickedness, The Holistic Diagnosis enabled the visualisation of opportunities and challenges for value creation, making it possible to identify and to define actions tailored to the needs and tools available in both precincts. Therefore, the systemic overview of such precincts considered "deprived" allows to overcome that helpless and pessimistic imaginary through the enhancement and promotion of a local culture that creates a solid precinct identity (sense of belonging/awareness of local resources), which changes the problem-solving mindset of the stakeholders.f new local culture towards one more holistic and autopoietic one.

As the main outcome was the outlined strategy of the study was the Circular City model for Atlantis (Figure 6.50) and Mirafiori South (Figure 5.46). The proposed Circular City models present a systems transition strategy towards a new re-design system model that creates/enhances local value within the territorial assets presented on each the Holistic Diagnosis, even though such goal was similar the nature of such transitions was utterly different from global north and south perspective. In the case of Mirafiori South precinct the systemic implementation that such model suggested the Regenerate Circular Action as the crucial lever to activate the new circular system for Mirafiori South precinct. This was due to the number of consolidated Regenerate strategies in the precinct, mostly community-related (a bottom-up nature). Therefore the government should target funds and programs to Adapt and Loop actions that are considerably not executed in the precinct. On the other hand, the systemic implementation for Atlantis proposed the Loop Circular Action as the critical lever to activate the new circular system for Atlantis precinct. Such an outcome comes from the to the strong influence of the upcoming Greentech SEZ, which has consolidated industrial looping strategies (top-down nature). Hence, the model suggests that CoCT should target more funds and programs to Adapt and Regenerate actions that are considerably not executed in the precinct. On that perspective, it can be seen that the nature of the leverage to active the system can be bottom-up as the Regeneration strategies in Mirafiori South or top-down as the Loop strategies in Atlantis. Still, the importance of such leverages is to influence the other Circular Actions directly activating the transition of the system. Furthermore, these outcomes should serve the networks of stakeholders who could sustain the implementation of the Circular City model to reach horizontal dialogue and collaboration between bottom-up initiatives and top-down support, to ultimate generate sources of value creation.

The framework results implied that Circular City model implementation should entail a systemic approach that can inform a CE policy design process within each precinct and a 'Time-Based Design' approach. On that view, at the policy-making level, these results aimed to influence the design process of local policies on both precincts. For that purpose, the framework examination approached multiple levels understanding the holistic nature of each precinct to foster better governance and disseminate innovative solutions towards a CE. Such levels are:

a. *On the technical level*: the Circular Actions implementations presented on each model where based, according to their technology readiness level, local energy and material flow (urban metabolism networks) through which result in the creation or redesign of local, circular supply chains which were radically different on each precinct. For instance, on Mirafiori South precinct, the technical aspect was more present among the community due to their direct partnership with research institutions for the implementation of circular strategies (i.e. Regenerate). Furthermore, in this particular case, the government has been supportive of providing technologies for local initiatives. On the case of Atlantis, the technicalities of the Circular City model are strongly related to the social and economic crisis of the precinct (unemployment and alcoholism). On that view, the government has supported community engagement and skills development programs that aim to generate a synergy between the community and the upcoming circular precinct. This contrast allows us to understand that the availability of technical aspects has a considerable variation between the global north and south precincts. Nevertheless, the framework was able to identify technical aspects the are hidden and could potentially support Circular Actions (i.e. ancestral practices with local vegetation).

b. *On the social level,* the influence and outcomes of the respective Circular City model were remarkably different as the socio-technical systems have different features and challenges; the contrast between the global north and south. On that view, the Mirafiori South precinct to tackle the socio-technical issues (depopulation, youth exodus and unemployment) the precinct has developed a strong network of Third sector organisation which has enabled more citizen-based ownership of local resources on through co-designing and co-implementing of new CE strategies. On the contrary, the Atlantis case has a more extreme situation on their socio-technical systems. The legacy of apartheid in the precinct has brought the socio-economic degradation of the precinct with high rates of alcoholism, unemployment and poverty. The framework outcome was influenced by the skills development program that can address such wickedness and support the third sector and cultural organisations to enable more citizen-based ownership of local resources to co-designing and co-implementing CE strategies (i.e. the integration of informal vendors or vulnerable population on circular business models). This influence in both cases at a social level presents the radical difference of the challenges on implementing a CE in extremely different socio-technical systems. The systemic approach allowed us to understand the interconnected nature of such embedded socio-technical challenges, to conceive tailored made CE strategies, enabling the production of livelihoods that do not depend entirely on external factors and that are resilient over time. That value creation will enhance the life quality attracting new population and more opportunities for the current and upcoming population.

c. *On the economic level,* the Circular Actions implementations presented on each model aimed at boosting circular business models for products and services on all Circular Actions, highlighting market opportunities and public-private partnership on CE business model. For instance, the case of Mirafiori South precinct presented circular business models based on urban assets such as the New Soil production from Sangone Park. On a slightly different direction, the Atlantis precinct is addressing circular business models focused on incentives for the industrial area based on green technologies. Particularly at this level, the outcomes of both precincts were slightly similar as both pursuits to overcome the systemic effects of de-industrialisation and reactivate economic growth a localised. Consequently, the suggested Circular City model on both cases intended to propose a value creation economic model for the precinct-based on local resources and skills, to generate a more resilient local economy. An economic system that is more coherent and tailored to the community cultural values, which fosters a transition into a productive and stimulating place to live and work. This aspect reflects the common factor on post-industrial precincts regardless of their nature how the downsizes process of de-industrialisation comes from an economy reliant exclusively on the global market.

d. *At a cultural level*, the proposed Circular Actions implementations presented on each precinct to be resilient require to meet today's cultural and economic interests enhancing the precincts identity. The nature of how the local culture developed on each precinct, in this case, is more related to the social policies that conceived these areas. For Mirafiori South precinct, the third sector has promoted the cultural heritage from the automotive era. At levels of CE, this awareness has been growing over the years at the community level; the Circular Action strategies are fostering a local culture and sense of belonging. In the case of Atlantis, unfortunately, the apartheid stigma has hampered the growth of local heritage. On that perspective, the framework outcome was influenced by the need to create a new identity based on value creation, that promotes territorial awareness concerning all local resources and sustainable development. Therefore, this sense of appropriation must include the ancestral cultures (Khoisan- Griqua - Xhosa) to conceive CE strategies are enrooted in the community. In both cases, the cultural approach was a contrast between frameworks. In the one side, the framework took advantage of a post-industrial cultural heritage site that has created a community identity, so it enhanced local culture. On the opposite side, the framework had to foster the creation of a local culture that include ancestral heritage. From different perspectives, the Circular City model not only to address the cultural system challenges through a new circular market scenario but more importantly, it delivers a long-term value creation strategy to make the precinct resilient.

At the policy-making level, these findings aim to become an inspiration model for policymakers in other post-industrial cities that have to deal with common Policy Gaps in the transition process to a CE. This research aims to unveil a systemic overview of the urban territory through a design process opening it up to a comprehension of the multiple opportunities for innovation towards a new model of political drivers on decision making. For policymakers, such Circular City model and along with the Systemic Design approach can support the creation of more efficient policies that can foster better governance on CE and disseminate innovative solutions to reinvent and shape more Circular Cities.

7.4 The role of the systemic designer in policymaking process towards a Circular City model

The outcomes of this research investigation demonstrated the value of Systemic Design as it has shown the means and knowledge to navigate this wicked scenario aiming to maximise the value of government towards a CE. The exploration of the systemic designer's roles within a policy design process (Kimbell,2015 & Bason, 2018) proposed Systemic Design Framework for Circular Cities (Figure 4.4). This outcome was supported by the role of the designer/researcher as a mediator with a skillset to anticipate future situations and create innovative results developing new approaches to the complexity on post-industrial precincts towards circularity (Giraldo Nohra et al., 2020).

With that in mind, the case study outcomes were characterised by the designers' supportive role as an "agent of change" (Green, 2013). Despite the different nature of each precinct presented in the examination, the systemic designer implied on advocating activate these precincts local assets involving an active stakeholder quadruple-helix, in this particular case focusing on CE matters. So, in order to develop complexity across the multiple connections in the system rather than attempting for a single, large, complex and unitary top-down solution which has been a predominant governance model in both deindustrialisation process to these precincts increasing their wickedness.

In both scenarios, the systemic designer served as a mediator between the bottom-up (represented by the community and third sector organisations) and top-down (embodied by the city government, industry and R&D). On that view, the systemic designer through both processes articulated the dialogue targeted for a CE policy cycle between quadruple helix parts to support a decision-making mechanism that promotes local assets and social innovations with a bottom-up nature to co-creating circular strategies enrooted in each precinct which can be sustained and scaled up through the synergy and support of the top-down institutions.

The lead role of a systemic designer in a CE policy design was able to moderate new synergies among the precinct stakeholders supported by the outcomes of the Systemic Design Framework for Circular Cities which contributed to a profound holistic comprehension of both precincts towards co-designing situated circular strategies for decision-making. Moreover, the examination allows the systemic designer to unwrap a decision making an instrument for CE policy design processes for each wicked precinct scenario and highlighted the potential synergies that support active cooperation among local actors.

Finally, the systemic designer role applied to the Circular city policymaking differs from other contexts of application such as Health, Agriculture or education (see Chapter 2), as the level of applied skills increases as complexity is higher in a Circular City scenario approaches almost all of the sectors and scales. On that view, the role of the designer gains more relevance in order to conceive it a systemic and resilient way. This characteristic reveals that the application of the Systemic Design on the Circular Economy field can be more challenging compared to the other fields because its system boundaries are broader than for instance when we are overlooking only at a value chain in agriculture. In this research investigation, the Systemic Design role lied in interweaving a systemic transition towards a Circular City model unveiling new governance ways to build local value and circularity.

7.5 The importance of Systemic Design for Value Creation in Circular Cities governance

According to the framework outcomes, through the Systemic Design approach was feasible to comprehend the nature of the different spectrum of wicked problems hampering its way into circularity. Both precincts have not overcome the wickedness of their deindustrialisation process caused by political or economic alterations in the case of Mirafiori South the exodus of FIAT, and in Atlantis, the end of the apartheid industrial subsidies. This research project analysis revealed that the interconnected nature of such critical drivers has a significant impact on how public policy has been implemented over the years in a continuous top-down approach—mainly promoting traditional planing and industrialisation programmes and policies, which do not promote local value.

The literature and case studies outcomes demonstrated that the CE wickedness is reinforced by a linear model of governance, which has challenges into "silos". Such bureaucratic model was a challenging situation during the data collection process as various local government institutions managed different data sources, or third sector organisation possed data that the government was not aware of. A government tradition that narrows challenges into analytical methods of problem-solving and encourages reactive decision making. The examination outcomes confirm the lack of articulation nature of the past government programs to tackle deindustrialisation phenomena, hindering the creation of local value and a transition to circularity in such precincts.

With this in mind, in order to achieve a transition of CE, that enhances local value in the long term is required to disrupt governance silos. With that purpose, this examination proposed a transformation on the prevailing policymaking/decision methods through the implementation Systemic Design approach. The outcomes of this systemic evaluation for both cases study undertaken with Systemic Design Framework for Circular Cities (Figure 4.4) introduced a more adaptive and collaborative policymaking framework, which included all precincts assets from opportunities to challenges for local value creation and all current levers policies & projects that could sustain future CE strategies.

The system assets on the Holistic Diagnosis (section 5.4 and 6.4) presented the "sleeping assets" or value generators, not acknowledged previously by other current government strategies towards circularity. For instance, in Mirafiori South, the outcomes exposed a substantial quantity of metalworking workshops that could unlock more reuse/repair strategies. Another example in Atlantis precinct was unveiled the strong relationship between indigenous biodiversity, public infrastructure, and ancestral cultures can cooperate to produce more adapt/regenerate strategies. On that view, the proposed framework with a 'Time-Based Design'approach proved that in different scenarios can reveal hidden assets which empower the generation local value and unluck a true potential for a Circular City model.

To unlock such value at policy level also required a crucial part of the framework outcomes on the policy analysis for each precinct (section 5.3.1.2 and 6.3.1.2) exposed what policies or grassroots programs have enhanced directly or indirectly circularity on different influences of government levels. On the case of Mirafiori South precinct, the Policy Framework revealed that the targeted CE exciting programs there is on a macro level the Torino city lab (2019) and on a local level the Mirafiori Cultura in Circolo. On a different perspective, the Atlantis precinct presented on its Policy Framework on a macro perspective addressing the CE there the CoCT Resilience strategy (2019) and in a local, there is the Greentech SEZ Atlantis. The contrast between the two outcomes resides that in most of the global north cities there are CE programs which are pretty recent, however, in the global south the programs are targeting sustainable development but not circularity per se. Also underlined in both cases, the lack of policy instruments and policy gaps to activate a circular process in the precinct. Furthermore, another visible difference is the fact that most circular programs one are coming from a bottom-up perspective in Mirafiori South and top-down in Atlantis. Such contrast demonstrates in one case that circularity can come modestly from a local value perspective to influence top-down decisions and, that in the other case topdown decisions requires to connect from a bottom-up/local value perspective. An attempt to addressed such missing synergies was purposed on the outcomes of the Stakeholder identification (section 5.3.1.3 and 6.3.1.3) both presented the quadruple-helix mapping of the main stakeholders involved to conceive a holistic and resilient vision of a Circular City model for each precinct.

On both precincts, the presented drivers address an examination of Circular City public policy leverages that were translated into CE actions. The outcome was introduced on the Synthesis Atlantis Circular City model (Figure 5.46 and Figure 6.50) and Implementation status for Circular Actions (Figure 5.47 and Figure 6.51). On both scenarios, new Circular City model system aimed that within a time-based design approach and anticipatory scenarios, deliver more future-oriented and sustainable-oriented policy actions to generate local value on an autopoietic view. Such outcomes on a systemic conceptualisation of local value were presented to managing authorities of each precinct in order to influence the vision of Circular City models developed in order to towards a more local value creation perspective.

Furthermore, through the Holistic Diagnosis system visualisation (section 5.4 and section 6.4) and Circular City model (Figure 5.46 and Figure 6.50) in both scenarios initiated a horizontal conversation within the quadruple helix key stakeholders. Those outcomes contribute with a common recognition of complex problems allowing to share responsibilities to cope with circular transitions. On that view, it conceded to build a broader vision of what circularity can mean on each precinct.

From a value creation perspective, the Localise Circular Action proved to be one of the pillars of both outcomes according to the systemic principles, as it embraces all Circular Actions establishing local synergies local symbiotic capital. Hence, the approaches on local value were different on both cases, for instance, Mirafiori South precinct implied fostering synergies within the industrial heritage, the natural peri-urban capital, the socio-technical system (working-class precinct), local industries and the city government. In the case of Atlantis precinct, was addressed towards partnerships between the surrounding indigenous natural capital, the local heritage (Khoisan- Griqua - Xhosa), the socio-technical system (Atlantis community), local/upcoming industries and the city government. Moreover, the implementations of each precinct Circular City model encourage the localisation of the precinct resources in living and industrial functions, which enhances local economy, environment and local communities, creating local value and making a resilient circular system.

Nevertheless, the research outcomes recognise that the proposed system transitions towards circularity on any scenario it implies a considerable disruption of the traditional investments schemes, jobs types, sociotechnical behaviours, knowledge and values (Mazzucato, 2018). With that in mind, the examination framework presented by this doctoral investigation gained a critical relevance with this outcomes as it introduces evidence on policy design instruments that can unlock the existing local value which are consistent and cohesive with long-term circularity targets. For instance, setting a different business culture that can promote more resilient jobs and shifting the socio-economic crisis.

7.6 A foresight approach Circular City model within a post-industrial precincts reality

Regardless of the different nature of the presented case studies, we could agree that in both precincts the systemic effects of deindustrialisation perpetuated over time are proof of the government's failure to address the wickedness in long term view. To address that these research outcomes presented the systemic implementation process of a Circular City model, that intends a policy change overtime on both case studies. In this process was presented the "actionable and proactive" mindset (see Chapter 2) of the Systemic Design that combined with a foresight vision, could introduce tangible outcomes in the short term while addressing broader actions in the long term. Therefore, the framework outcomes within a 'Time-Based Design' conceive the Circular Actions implementation impacts within a different timing for their execution. The results on both cases suggested a gradual introduction CE policy/strategy for the precinct developing within a short, medium and long term, where the short (executed) and medium (planned) ones are designed to support future implementations (potential). In order to do so, the Systemic Design study delivered a decision making an instrument that can address the post-industrial wickedness within a long-term resilient perspective. On an instant effect, such an instrument can actively strengthen cooperation among local actors on the ongoing plans towards a circular precinct model.

With that in mind, to illustrate the Circular City model systemic implementation on post-industrial precincts, it is worth to narrow insight into their impacts on a short (executed), medium (planned) and long-term (potential) actions in order to understand the long-term horizon effect on CE policy-planning process in such precincts:

SHORT-TERM IMPACT

These results refer to the immediate outputs of the current executed implementations identified in both precincts, respectively: fifteen on Mirafiori South (Figure 5.47) and ten on Atlantis (Figure 6.51). According to the research outcomes, the nature of these short term actions was from previous policies, community programs and funding opportunities. The examination underlined that such actions are considered critical leverage to activate the rest of the proposed Circular City model on each precinct in the case of Mirafiori South are Regenerate actions and on Atlantis are Loop actions. Such outcomes must encourage managing authorities into scale up these results into significant impacts on a medium and long term policy perspective. In order to do so, they must involve actively of all stakeholders as end-users to anticipate future strategies on the mid - long term horizon, always addressing today's changing drivers (e.g., research and innovation initiatives, technological development, active economic sectors with leading industries, key change-makers).

MEDIUM-TERM IMPACT

These results refer to the mid-term impacts of the currently planned implementations identified in both precincts, respectively: twelve on Mirafiori South (Figure 5.47) and eight on Atlantis (Figure 6.51). In compliance with the research outcomes, the nature of these mid-term actions come from upcoming government programs and funding opportunities on CE. The research indicated that such actions are mid-term implementations that are related to the latest CE programs which are about to be executed on each precinct. In the case of Mirafiori South are the upcoming planned implementations by the programs Mirafiori Cultura in Circolo and Torino City Lab and on the case of Atlantis is the expected, planned implementations from the GreenTech Atlantis SEZ. On that perspective, mid-term actions can present an essential input in outlining an impactful way to approach the CE policy goals on the future policy-making process, in a more systemic and territorial way. Furthermore, the echo of these prosperous mid-term actions can also have an impact at the city level, producing a broader spectrum of policies and programs that promote the assign of more funds for projects related to CE. From a governance perspective, the existing mid-term strategies are pilots to foster more research and investment measures on CE at the city level.

LONG-TERM IMPACT

These results refer to the long-term impacts of the potential implementations identified in both precincts, respectively: twelve on Mirafiori South (Figure 5.47) and twelve on Atlantis (Figure 6.51). The nature of these long-term actions come from the Holistic Diagnosis outcomes (5.4 and 6.4 section). After an exhaustive examination of the territorial opportunities, this research proposed based on the data presented potential circular implementation that could be suitable for each precinct from a systemic point of view. These proposed implementations underline the opportunities that each precinct has in order to accomplish a Circular Cities model. On that view, to conceive a foresight vision on each Circular Cities model, all actions proposed to be framed on the long-term targets such as the 2030 sustainable development goals. However, in the case of Turin (Mirafiori South precinct) a global north city in particular within the EU there are a wide variety of EU policies towards a CE as - Circular Economy Package, EU Bioeconomy Strategy, and the EU Plastics Strategy (EC, 2019), that can set long-term horizons targets on for the Mirafiori South Circular City model. In the case of the Cape Town (Atlantis precinct) Global South, in particular, the African continent does not have such collective CE target policies to establish long-term goals. However, on a macro perspective addressing the CE, there is the CoCT Resilience strategy (2019), that can set long-term horizons targets on for the Atlantis Circular City model.

Moreover, the framework outcomes to provide a foresight perspective on each precinct's Circular City model, the systemic implementation implies a long-term effect on CE policy planning process. To do so, the framework provided a series of implementation impacts indicators (Table 5.27-29) (Table 6.24- 26).

Also, these result delivers an illustration of how short-term actions on wicked scenarios of deindustrialisation framed in a holistic approach can deliver a more powerful impact on the long-term. This Systemic Design approaches on policy proofs that the transition to CE will require this kind of methodology as it delivers a long-term value creation strategy to make the precinct not only circular but resilient.

Chapter 8

Conclusions

This section presents the overall conclusion of the thesis investigation. In particular, it presents how the aim and objectives of this research project were achieved. Also, it is discussed the contribution to knowledge, the limitations encountered throughout this research process, and suggestions for future work.

8.1 Meeting the Research Aim and Objectives

This research tackled the problem of governance inefficacy to approach cities wicked problems enabling their capacity to tailor circular economy strategies, producing city policies that are not inclusive or cohesive and do not produce local value over time. The aim was to examine how a Systemic Design approach can support a Policy Design process on Circular Economy towards a Circular City model in post-industrial precincts. The next sections summarise how the research objectives were accomplished during the thesis.

Objective 1: To critically review the literature on System Transitions, Design for Sustainability, Systemic Design, Co-design practices, Circular Economy Policy Design and identify a knowledge gap.

An extensive literature review contributed to setting the scope of this research around CE policy design and outlining the problem to be investigated, the need to investigate in which ways a Systemic Design approach to CE policy can establish a more inclusive and cohesive policy design process for a circular model relationship with the context to develop local value. As an outcome, a Systemic Design lens on Policy Design for Circular Economy decision-making was drawn as a conceptual approach to inform the following phases of this examination (see Chapter 2).

Objective 2: To develop a theoretical proposition to co-design a Circular City framework tailored for Post-industrial areas.

This scoping study was framed by a specific literature review targeting the evolution of the Circular City model carried to reach a theoretical proposition on Systemic Design approaches for a Circular City Framework, as set out in the rest of this Chapter. For that aim, the literature review from the urban sustainability background to the currents models around the Circular City (Figure 4.1). Ultimately, the researcher carried a method of design synthesis of the outcomes into a theoretical proposition to inspire a Circular City Framework on the lens of Systemic Design for post-industrial precincts. This research outcome complements the Systemic Design methodology as it adds the scope of Circular City model elements narrowing towards a CE perspective for post-industrial precincts. Moreover, the framework delivered a co-design approach to tailor CE strategies that can coexist to deliver social and economic welfare and activate new mechanisms for value creation in post-industrial areas.

Objective 3: To undertake case studies aimed at developing Systemic Design approaches for Circular City frameworks to co-designing situated circular strategies for decision-making.

The further examination of this framework was through the cases study of Mirafiori South Precinct in Turin (Italy), and Atlantis precinct in Cape Town (South Africa) which allowed bridging from the theoretical proposition of Systemic Design Framework for Circular Cities to tangible practices co-designing situated circular strategies for decision-making. The applied framework in both case studies, delivered tool for governance for the CE innovation in public procurement. Firstly, the holistic approach provided by the framework also allowed visualising each precinct's main barriers to wicked problems translated into the policy gaps. The outcomes presented a methodology that can trigger innovative processes on CE policy design process, which implies sharing knowledge and experiences among a quadruple helix building an innovative CE governance in the public sector (see Chapter 5 and 6).

Objective 4: To assess the research's potential impact and contribution beyond the particular case studies

A research synthesis was conducted to assess the case study application aimed to oversee the strengths and challenges of the proposed framework implementation through examining four levels of innovation: technical, social, economic and cultural. Including the issue of 'value creation' on CE policymaking process by proposing that Circular City model system through anticipatory scenarios, could bring more future-oriented and sustainable-oriented policy actions to enhance local value creation. Also, the assessment of the examination findings on Systemic Design capability to navigate this wicked scenarios aiming to maximise the value of government tackling and be supportive in CE policy foresight practices and strategic decision making in cities (Chapter 7).

8.2 Overall conclusions

This research was inspired by cities increasing interest in Circular Economy policies as an essential model of design, production and consumption, contributing to sustainable development and wellbeing. At a city-level scenario, what does the transition toward a CE entail, and what can it do? To achieve a Circular City model is imperative to overcome the “wicked problems” at a governance level, represented on the current environmental, social and economic challenges. Such wickedness has manifested itself in cities through radical changes in politics, markets, human population densities and urban fabric; those transformations haven been so accelerated that not all cities could cope with the demands of the market and population. This drastic shift has left many formerly manufacture/extractive or Fordist cities with the deprived and outdated urban fabric; this has resulted in the rise of post-industrial precincts whose traditional linea government approach have taken perpetuated such complexity over time. Thereby to understand the CE wickedness, it is required a deep comprehension of the system complexity and the ecology of its relationship.

On that view research tackled the problem of governance inefficacy to approach cities wicked problems enabling their capacity to tailor circular economy strategies, producing city policies that are not inclusive or cohesive and do not produce local value over time. On that view, the research explored how a Systemic Design approach can support a Policy Design process on Circular Economy towards a Circular City model in post-industrial precincts. This thesis argues that CE policymaking wicked scenarios are often reinforced by a linear model of governance, which encloses problems into “silos” and limits the understanding of the complex nature of such systemic problems. Therefore, to achieve a transition of CE in cities, it is needed a radical shift towards a more adaptive and collaborative policy framework. On that perspective, city governments approach CE policy instruments that enhance local value which is cohesive with long-term environmental goals of a Circular City.With this in mind, this research emphasised the role of systemic design as a decision-making practice for CE policymaking. For this research project, the Systemic Design for a Circular City was investigated through its application to post-industrial precincts, chosen as a unit of analysis for this decision-making case study research. Furthermore, it is essential to highlight that this research does not focus on policies themselves, but to explore the Systemic Design methodology for a governance “paradigm shift” towards a collaboratives approaches for value creation on Circular Cities from a ‘Time-Based Design’ perpective.

LITERATURE REVIEW

The research approach an extensive literature review that contributed to setting the scope of this examination around CE policy design and outlining the problem to be investigated, the need to study in which ways a Systemic Design approach to CE policy can establish a more inclusive and cohesive policy design process for a circular model relationship with the context to develop local value. To provide background for this research, a picture of the wicked problems of CE was drawn, to comprehend the nature of the current issues of the governments which address such problems linearly. The perpetuity of this challenges overtime has resided at the decision-making processes from both top-down perspectives, where reactive decision making on development strategies has been unsustainable in terms of lack value creation on local resources from material flows, livelihoods, community networks, local economies, cultural heritage and environmental ecosystems.

So to tackle the wicked problems rooted in the CE governance, this examination adopted systemic thinking and a holistic approach to innovation in CE policy. The result of the application of Systemic Thinking to the design discipline narrowed the examination towards the Systemic Design (SD), which addresses wicked problems in complex socio-technical systems. In particular, for this research project, it was implemented the Politecnico di Torino SD approach, which contributed systemic and interconnected solutions to the complexity of the current situation, incorporating economic, environmental and social contexts. Significantly, the Holistic Diagnosis was presented as a method to activate ways towards a resilient system. Such an approach acknowledges the need for a quadruple helix (a combined top-down and bottom-up approach) to cooperate in order to address such CE complex. With this in mind, the capabilities of SD can serve effectively to the components of participatory co-design that Policy Design processes require. The SD favours the visualisation of opportunities for value creation, enhancing the active collaboration between stakeholders, and boosting locally-based circular value chains.

Furthermore, systemic designers can support the process of policymaking by stressing not only on numeric trends but also on qualitative aspects such as culture, uses or local resources which is crucial for the development of a CE in a city landscape. For that aim, the SD can identify and comprehend the CE barriers and levers from a systemic thinking point of view. Moreover, since tackling CE wicked problems is an evolving process that requires multiple change-makers able to face with complexity, the systemic designer mindset and methodology can be supportive in CE policy foresight practices and strategic decision making in cities. On that view, the literature review delivered a Systemic Design lens on Policy Design for Circular Economy decision-making was drawn as a conceptual approach to inform the following phases of this examination.

CIRCULAR CITY MODEL

With that in mind, the research addressed the first research question: *"What Circular City model can be envisioned post-industrial precincts, and what are the challenges and opportunities for a transition?"* For that aim, a scoping study was framed by a specific literature review targeting the evolution of the Circular City model carried to reach a theoretical proposition on Systemic Design approaches for a Circular City Framework. For the research purpose, the scoping study approached from the urban sustainability background, currents models around the Circular City and their limitation and what model of governance this must imply. Ultimately, the researcher carried a method of design synthesis of the outcomes into a theoretical proposition to inspire a Circular City Framework on the lens of Systemic Design for post-industrial precincts, in order to to be applied on both case studies. These research outcome complements the Systemic Design methodology as it adds the scope of Circular City model elements narrowing towards a CE perspective for post-industrial precincts.

Moreover, the framework delivered a co-design approach to tailor CE strategies that can coexist to deliver social and economic welfare and activate new mechanisms for value creation in post-industrial areas. The Systemic Design Framework for Circular Cities involves a quadruple helix and designers as mediators within a bottom-up and top-down that fits each scenario, to co-create CE strategies and to deliver social and economic welfare activating new mechanisms for value creation in post-industrial areas. Also, it delivers a holistic overview of complex post-industrial scenarios which can activate a Circular City model that arises from the appraisal of the resources offered by post-industrial precincts.

CASES STUDY

Afterwards, the research was followed by the second research question; *"In what ways a systemic designer can co-design policies for a post-industrial precinct that encourage their transition towards Circular City?"* For that aim, a further examination of the Systemic Design Framework for Circular Cities was proposed through the cases study of Mirafiori South Precinct in Turin (Italy), and Atlantis precinct in Cape Town (South Africa) which allowed bridging from the theoretical proposition of Systemic Design Framework for Circular Cities to tangible practices co-designing situated circular strategies for decision-making (Chapter 5 and 6). Both considering post-industrial legacy as a pillar for to generate a Circular City model yet, the nature of both scenarios (Europe/Africa) is radically different which brought to the outcomes a broader and different understanding on how to activate decision-making process to transition into a Circular City model.

The first case study was the post-industrial precinct of Mirafiori South in Turin (Italy) as the most crucial representation of Italian city-factory. Mirafiori South was regarded as an exemplary case to investigate as it was considered to be the heart of the Fordist model of automotive mass production in the history of Italy. On that view, the undertaken Systemic Design Framework for Circular provided a critical lesson for Mirafiori South to become economical, social and environmentally resilient, fostering a systemic transition within value creation amplifying local value chains which are reliant on local know-how and labour networks. On that purpose the framework provided a profound holistic comprehension of the Mirafiori South precinct, providing an extensive data collection that highlight the complexity of designing a Circular City model that can overcome the Mirafiori South wicked barriers to the CE. Those barriers mostly are embedded in the dominant automotive mass production culture that conceived the precinct fostering a linear model of governance which has inhibited the generation of local value. Such "Siloed" government focused was reflected on the modest outcomes of several urban-regeneration and re-industrialisation programs to reactivate the precinct. In order to address a better understanding of such challenge, the Holistic Diagnosis enabled the visualisation of opportunities and challenges for value creation, making possible to identify and to define actions tailored to the needs and tools available in the Mirafiori South precinct. For that aim the framework conducted a fundamental part in scoping the precinct context within a quadruple helix collecting feedback from all stakeholders groups; civil servants (city of Turin), industry (Turin Chamber of Commerce, and community (Third sector organisations - Mirafiori Foundation) and education (Research institution and local schools) in order to reach horizontal dialogue and collaboration between bottom-up initiatives and top-down support. The result of the framework delivered the Mirafiori South Circular City model (Figure 5.47). The systemic implementation that such model will suggest the Regenerate Circular Action as the crucial lever to activate the new circular system for Mirafiori South precinct, as it will influence the other Circular Actions directly activating the transition of the system. The Regeneration action shows that the nature of most Circular Action in the precinct currently come from a bottom-up perspective proving the growing engagement between community and circularity. Regeneration actions are critical to a Circular City model but also target funds and programs to Adapt and Loop actions that are considerably not executed in the precinct. This framework results implied that for an implementation process of a Mirafiori South precinct Circular City model should entail a systemic approach to stakeholder engagement and activity development, these results aim to change local policies on the precinct, fostering better governance where the bottom-up meets the top-down. The proposed circular strategies in order to be resilient must meet current precinct's cultural and economic interests keeping a strong sense of belonging. Indeed, the Mirafiori South Circular City model addresses not only the cultural system challenges as depopulation and unemployment through a new circular market scenario but more importantly; it delivers a long-term value creation strategy to make the precinct resilient. The precinct examination of this research project through systemic design aimed to influence the decision-making process on the current Living-lab plans of the precinct that aim to experiment with circular economy strategies. The results of this study aim to facilitate a better un for the area understanding of the potential CE strategies for a resilient Circular City model on a Global North perspective.

The second case study presented post-industrial precinct of Atlantis in Cape Town (South Africa), the most significant examples of African city-factory. Atlantis embodied an extreme case study to learn from, in which the narrative of segregation in post-industrial precincts corresponds with reality, established in as part of the apartheid planning policy through a program of incentives to create the heart of the Industrial cluster model for mass production in the history of South Africa. On that scenario, the undertaken Systemic Design Framework for Circular provided significant input for Atlantis to overcome the stigma of the deprived area fostering a systemic transition within value creation amplifying local value chains which are reliant on local know-how and labour networks. On that purpose the framework provided a profound holistic comprehension of the Atlantis precinct, providing an extensive data collection that highlights the complexity of designing a Circular City model that can overcome the Atlantis wicked barriers to the CE. Those barriers mostly are rooted in the dominant apartheid influence that conceived an industrial culture based on external capital promoted by a linear model of governance which has inhibited the generation of local value, increasing the high levels of frustration and lack of trust from the local population towards the government. Such "Siloed" government focused was reflected on the modest outcomes of re-industrialisation programs to reactivate the precinct. The Holistic Diagnosis enabled an understanding of such challenges towards value creation, identifying tailored actions to the needs and mechanisms available in the Atlantis precinct. On that purpose the framework conducted a fundamental part in scoping the precinct context within a quadruple helix collecting feedback from all stakeholders groups; civil servants (CoCT), industry (WESGRO, and community (Atlantis SEZ Community Stakeholder Network) and Research (GreenCape) in order to reach horizontal dialogue and collaboration between bottom-up initiatives and top-down support. The result of the framework delivered the Atlantis Circular City model (Figure 6.49). The systemic implementation that such model poised the Loop Circular Action as the crucial lever to activate the new circular system for Atlantis precinct, this is due to the strong influence of the Greentech SEZ. The nature of the predominant loop actions come from a top-down perspective as the government has targeted industry supports towards circularity. Hence, the model approaches Loop actions as the key to a Circular City model that means CoCT should target more funds and programs to Adapt and Regenerate actions that are considerably not executed in the precinct. This framework results implied that for an implementation process of an Atlantis precinct Circular City model entails a systemic approach that requires a robust stakeholder engagement to seize opportunities like the Greentech SEZ and not fail like another industrial cluster. That means these results aim to change local policies on Atlantis precinct, fostering better governance where the top-down meets the bottom-up. The proposed circular strategies in order to be resilient must meet simultaneously today's cultural and economic interests creating a new precincts identity. On that view, to overcome the apartheid stigma of the deprived ghetto, the Atlantis precinct requires to create a new identity based on value creation, that promotes territorial awareness concerning all local resources and sustainable development. Therefore, these sense of appropriation on the Atlantis Circular City model must include the ancestral cultures (Khoisan- Griqua - Xhosa) in order to conceive CE strategies are enrooted in the community.

EXISTING POLICY-MAKING PROCESSES

In both case studies, the results have a close relationship with existing CE policymaking processes, as described in section 6.7. The design process of the Circular City models on each precinct aimed to influence upcoming government programs and funding opportunities on CE, which are about to be executed on each precinct. In the case of Mirafiori South, the results of this examination aim to influence the current policymaking process for the Torino City Lab on targeting circular economy strategies to transform it on the first circular precinct of Turin. On Atlantis precinct, the investigation outcomes will influence the ongoing policymaking process the GreenTech Atlantis SEZ, which has the purpose to transform it on the first circular precinct of Africa. Therefore, the influence on the current CE policymaking process on each precinct can also have an impact at the city level, producing a broader spectrum of policies and programs that promote the assign of more funds for projects related to CE. From a governance perspective, the proposed investigation outcomes aim to foster more research and investment measures on CE at the city level.

On a foresight vision perspective, the examination outcomes are framed on the current long-term CE policymaking process. In the case of Turin a global north city, the EU has a broad spectrum of CE policies (Circular Economy Package, EU Bioeconomy Strategy, and the EU Plastics Strategy) that can set long-term horizons targets on for the Mirafiori South Circular City model. In Cape Town, a Global South, in particular, the African continent does not have such collective CE target policies to establish long-term goals. However, on a macro perspective addressing the CE, there is the CoCT Resilience strategy (2019), that can set long-term horizons targets on for the Atlantis Circular City model. The proposed outcomes can be an essential input in outlining an impactful way to approach the CE policy goals on the current policymaking process, in a more systemic and territorial way

VALUE CREATION

The outcomes of both case study led to approach the third research question: *"What value can Systemic Design approaches bring to the field of Public Policy on Circular Economy in cities beyond the scope of post-industrial areas?"*. For that purpose, this thesis addressed the issue of 'value creation' CE policy-making process by proposing that Circular City model system through anticipatory scenarios, could bring more future-oriented and sustainable-oriented policy actions to enhance local value creation. Also, examination findings have shown that Systemic Design provides knowledge to navigate this wicked scenarios aiming to maximise the value of government tackling and be supportive in CE policy foresight practices and strategic decision making in post-industrial precincts.

The applied framework in both case studies, delivered tool for governance for the CE innovation in public procurement. The outcomes presented a methodology that can trigger innovative processes on CE policy design process, which implies sharing knowledge and experiences among a quadruple helix building an innovative CE governance in the public sector. The framework considered that such collaborative policy design processes were essential towards value creation in a long-term horizon: they enhance capacity building, they build trust, and mediate the power through cross-sector collaboration. Moreover, the systemic perspective applied to the Circular City model means to favour adaptive governance, whose outcomes are iterative and autopoietic, creating endurable public value. Still, much more research requires to be done to examine different dynamics between actions and test those already Circular City models identified; this framework as it has could be translated into other post-industrial contexts.

On both scenarios, the study confirmed the framework to be relevant to generate Circular City model system that within anticipatory scenarios, deliver more future-oriented and sustainable-oriented policy actions to generate local value on an autopoietic view. Such 'Time-Based Design' outcomes on a systemic conceptualisation of local value were presented to managing authorities of each precinct in order to influence the vision of Circular City models developed in order to towards a more local value creation perspective. With that in mind, the examination framework presented by this doctoral investigation gained a critical relevance with this outcomes as it introduces evidence on policy design instruments that can unlock the existing local value which are consistent and cohesive with long-term circularity targets.

8.3 Contribution to Knowledge

As an outcome of this research, multiple goals and methods from various sources were put synchronically into a robust framework, endeavoured at supporting the systemic designer in co-designing CE policies to activate Circular City models. This thesis outlined how the role of the systemic designer can influence the policy-making process for CE providing a space for design practices to be involved in the construction of policies addressing designers' skills and knowledge towards higher goals, in this case, the transition towards a CE.

Systemic Design applied to the Circular Economy policies differ from other design approaches mentioned in Chapter 2 from Service Design to Design Thinking, as this discipline approaches a wide range of scales to construct a holistic vision of the system. To that purpose, the systemic design assesses a territory approaches from the micro to the macro relationships of a system. Therefore, it has a multiscale approach that other design approaches do not cover. On a CE policymaking perspective, this methodology allows conceiving resilient strategies that transform the environment and economy more effectively.

On regards, the Systemic Design implemented to the Circular city policymaking differs from other contexts of application such as Health, Agriculture or education (see Chapter 2), as the Circular Economy approaches almost all of the sectors and scales in order to conceive it a systemic and resilient way. This characteristic reveals that the application of the Systemic Design on the Circular Economy field can be more challenging compared to the other fields because its system boundaries are broader than for instance when we are overlooking only at a value chain in agriculture. In this examination, the Systemic Design role lied in interweaving a systemic transition towards a Circular City model unveiling new governance ways to build local value and circularity.

Furthemore, the Systemic Design method proposed here was implemented in a real-world scenario and left open for further adaptations by other systemic designers working with municipalities to address aiming to address a Circular City model of their own. Moreover, the suggested 'Time-Based Design' approach was developed and verified within the context of CE policy in post-industrial precincts, contributing to expanding the systemic design domain to a significant application area. The framework contributed to empowering such precincts who frequently are considered deprived and ghettoised, improving their awareness on their local resources, skills and culture to reach value creation.

The approach proposed synthesis and visualisation pave an efficient way to interpret current and new circular strategies which developed territorial thinking immersion on both precincts among the quadruple helix stakeholders establishing a standard comprehension of the current complexity of the system from the urban fabric, demography, economic, cultural and policy perspective. Such outcomes of the framework highlighted how the CE requires thinking in longer time horizons and, therefore, enabling long-term decision-making, in order to reinforce a new local culture.

The framework introduced a stakeholder engagement had success because through the examination process; the stakeholders were stimulated to think holistically and to overcome divisions between different sectors and roles, pursuing shared objectives for the precinct. The researcher had the opportunity to develop those engagements engaging directly with municipalities, in order to influence the adoption of the Circular City model on the future developments of the precincts. On that scenario, the researcher/designer proved its moderator capability and skillset to drive innovation processes.

Moreover, the applied approach enabled the visualisation of opportunities for value creation supported an active collaboration between the quadruple helix stakeholders, and boosting locally based value chains, delivering innovative strategies on the micro/macro scale and the short/long term in order to implement a Circular City model successfully. Such collaborative policy design processes, developed among different stakeholders, is essential to moving towards value creation in a long-term horizon: they enhance social learning and capacity building, they build trust, and mediate the power through cross-sector collaboration. The framework highlighted how the systemic designer's mindset and methodology could be supportive strategic CE decision making, developed in a collaborative and multi-stakeholder process.

The outcomes present that the applied framework on both precincts implied Systemic perspectives and participatory methodologies that trigger innovative processes of sharing knowledge and experiences among different stakeholder and can build innovation in the public sector. On that view, applying a systemic perspective into those strategies means to favour adaptive governance, whose outcomes are iterative and autopoietic, creating endurable public value.

Finally, the proposed framework exemplifies disruptive and transformative dynamics as a practical methodology to enhance the CE transition. Moreover, this approach supported these results for Circular Cities model in Post-industrial precincts, which brought a systemic policy approach for an effective CE policy-making, incorporating different policy interventions to boost the cooperation—in this way, creating a doorway where designers, managing authorities, industry, and citizenship can effectively co-develop new policy opportunities.

8.4 Limitations of the Study

The proposed Systemic Design framework for the generation of Circular Economy policies towards value creation, deliver an extensive and holistic research background. In both scenarios, the researcher was able to reach out to the relevant managing authorities as they consider the examinations were relevant to the current development process of each precinct, providing access to each city database. Nevertheless, it is likely to point out some constraints related to the Systemic Design methodology, which have been introduced at the research phase.

One of the main challenges in adopting collaborative policy-making on circularity, such as the SD for different scenarios is the accessibility to database consultation. In the early research phase, this challenge is widespread as database platforms in each country have different units, language, and update status. On that view, in both case study, the required data was not centralised, and it was necessary with the support of the managing authority supporting this research to send a request of different databases to different city agencies. In that phase, the researcher faced the problem of different city agencies in “silos”, as some of them wanted to cooperate with others not. Also, this is reflected in the data update this affected the research outcomes. In the end, it was possible to gather most of the data, thanks to the direct relationship with the city officials otherwise was impossible to carry such research. This limitation proved that so many of the decisions are “behind closed doors” if city agencies are unable to share among them vital data. In most cases, the critical point is to find an average amount of available data, to make a holistic diagnosis properly. Moreover, this process of quantitative and qualitative data collection requires robust cooperation between stakeholders and managing authorities, which is limited by the siloed-shaped bureaucracy.

Besides to approach policy design processes within the framework, it is required a direct engagement with civil servants, industry, and community representants which allows increasing awareness on local resources, opportunities, and challenges. Unfortunately, the bureaucratic cultural paradigm, firmly fixed into a top-down approach, limited the cooperation among all the actors. That is why this is recognised as a critical point for SD to enable a quadruple helix approach, which is needed for adaptive governance.

Another critical factor that the research encountered was the time frame that managing authorities need to establish in a Policy Design process: in many cases, there is a fixed period to execute specific actions for which a specific budget has been already defined. On that view, the framework proposed actions that only serve on a current scenario, and for an immediate change, which is not possible because policies have effects after several years after release. For the same reason, the framework impacts are complicated to measure because they are designed on a long time perspective. Therefore, such effects must be planned with a foresight vision on short, medium and long term view, in order to address the change and broader value creation.

In particular, other limits on adopting collaborative policy-making on circularity where tangible on the roundtable co-design process, which suggested the repercussions and limits of the collaborative processes that faced a Systemic Design approach in both contexts. The organisation such sessions can be challenging as the participants of the community tend to be sceptical, or each stakeholder tends to have their own agenda for their precinct. For instance, in Atlantis collaborative process have been criticised over the years, resulting in mediocre results. This case study highlights the political and historical limitations that this collaborative process reflected on tensions between the community and the government, which makes it more challenging to create a neutral ground for discussion between the stakeholders.

Lastly, it is essential to clarify that the role of the researcher/designer in for this examination was framed as a mediator who starts a co-design process with managing authorities and local stakeholders. In particular, in this circular participatory process designers are rare to take part in this policy-making process, so there is a limitation from the stakeholders to understand the role of the designer in a policy.

Still, the implementation of the outlined Circular City model lies beyond the scope of this doctoral research, as well as the assessment of the effects of the associated circular innovations.he effects of the associated circular innovations.

8.5 Recommendations for Future Work

The contribution of this study lies within the activation of post-industrial precincts to transition towards a Circular City model. Nevertheless, much more research is required to be done, the subsequent recommendations for future academic and professional opportunities emerged from the research project:

- To facilitate the adoption and dissemination of the framework amongst civil servants, it essential that city government promote with training the skills necessary to include systemic design practices on their decision-making process.

- The framework could be translated in different contexts, further developing this approach to another kind of precincts (e.g. historical or harbour precincts) or a broader approach for the entire city or regional scale.

- At levels of Circular Economy governance, this thesis reveals potential future opportunities on adopting collaborative policymaking on Circularity as it exposes the importance to conceive the CE policies within a systemic vision of the territory and a quadruple helix approach. On this process, the participatory component proves to be a pivotal element to ensure resilience for circular strategies. Furthermore, these participatory approaches provide the top-down and bottom-up approaches in order to deliver circular policies that are more coherent with the reality of their stakeholders. This kind of approaches if implemented at the city, regional or national level, could provide a useful endurable and foresight effect on the upcoming CE policies, based on the promotion of the local assets and levers. In this view, instead of presenting fixed systemic design outcomes, an ongoing process of policy transformation can be activated.

- In the case of Atlantis precinct, the GreenCape, WESGRO and CoCT officials want to keep the discussion forward on the results of this research. This research provided critical feedback to the implementation process of the Greentech SEZ, which aims to turn Atlantis in a circular precinct overall.

- In the case of Mirafiori South precinct, the City of Turin Department of Innovation and Smart City wants to keep the discussion forward on the results of this research to test some of the outcomes in their ongoing Living lab program for the precinct as the first circular precinct of Turin.

CONSIDERATIONS ON COVID-19

At the same time, this doctoral research concluded that the COVID-19 crisis breakout influence strongly the relevance of future work on this doctoral research. On the midst of this global pandemic, most governments have demonstrated not ready for the current state of the art. After this global impact, how should look like the next circular economy? We need to optimise our health system capacities to increase our resilience to future shocks, climate inequality an opportunity to rethink our value system. We need to purpose a framework that allows us to be ready for the next catastrophe. Today, Cities play a crucial role are on the frontline of responses to the COVID-19 crisis to implement nation-wide measures. At the same time are the laboratories to reconstruct our economy, providing scenarios of collaboration (top-down & bottom-up) for innovative recovery strategies. COVID-19 accelerated the shift towards a new urban paradigm towards inclusive, green and circular cities. On that view, the framework proposed by this doctoral research becomes more relevant than ever to be further explored.

On that view, the framework can be practical to beapplied to the upcoming cities recovery strategies from the COVID-19 pandemic, which can propose innovative circular strategies draws circular to build back better cities.

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Annex I

Mirafiori South precinct data collection

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Urban Fabric	Infrastruscture	coordinates		MIRAFIORI SUD		Latitudine (DMS - degrees, minutes, and seconds)45° 03' 00" Nord; Longitudine (DMS - degrees, minutes, and seconds) 7° 40' 00" Est	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		Surface area	TOTAL	MIRAFIORI SUD	m2	11.491.000 m2	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
			Green Surface	MIRAFIORI SUD	m2	1.260.160 m2 (11%)	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
			Connectivty space	MIRAFIORI SUD	m2	7.965.928 m2 (69,3%)	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
			Area of buildings	MIRAFIORI SUD	m2	2.264.912 m2 (19,7%)	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
			Total buildings	MIRAFIORI SUD	buildings	1.825 units	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
		Non-residential buildings	Total Non-residential buildings	MIRAFIORI SUD	buildings	628 UNTIS	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Commercial	MIRAFIORI SUD	buildings	161 UNTIS (25,6%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Industrial	MIRAFIORI SUD	buildings	281 untis (44,8%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Religiuos	MIRAFIORI SUD	buildings	15 untis (2,4%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Unknown	MIRAFIORI SUD	buildings	58 untis (9,4%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Ricreational	MIRAFIORI SUD	buildings	8 untis (1,3,%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
		Non-residential buildings	Education	MIRAFIORI SUD	buildings	32 untis (5,1%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
		Non-residential buildings	Public Administrion	MIRAFIORI SUD	buildings	66 untis (10,2%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Accommodation facilities	MIRAFIORI SUD	buildings	4 units (0,6%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Agriculture	MIRAFIORI SUD	buildings	3 untis (0,5%)	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
		Housing	Total housing units	MIRAFIORI SUD	buildings	1.197 units	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
			Total social housing units	MIRAFIORI SUD	buildings	101 units ATC	2018	erritorial Agency for the habitat	http://geoportale.comune.torino.it/web/

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Urban Fabric	Infrastrucsture	% of green spaces	% of total surface which is destined for green spaces	CITY OF TURIN	buildings	35.648.000	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
				MIRAFIORI SUD	sqm	1.697.845	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		% Surface brownfields	% of total surface which is destined for brownfield areas	CITY OF TURIN	sqm	12.545.000	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
				MIRAFIORI SUD	areas	19 areas	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		Total of public/ private green areas	Total of public/private green areas	CITY OF TURIN	sqm	48.777.000	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
				MIRAFIORI SUD	sqm	3.139.872	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
	Urban Metabolism	Climate / Meteorological data	Precipitation -Average annual precipitation (mm)	CITY OF TURIN	mm	544	2017	Environmental Data Report ARPA	http://www.regione.piemonte.it/ambiente/aria/rilev/ariaday/ariaweb-new/
				MIRAFIORI SUD	mm	488	2017	Environmental Data Report ARPA	http://www.regione.piemonte.it/ambiente/aria/rilev/ariaday/ariaweb-new/
		Climate / Meteorological data	Relative humidity	CITY OF TURIN	%	67	2017	Environmental Data Report ARPA	http://www.regione.piemonte.it/ambiente/aria/rilev/ariaday/ariaweb-new/
				MIRAFIORI SUD	%	72	2017	Environmental Data Report ARPA	http://www.regione.piemonte.it/ambiente/aria/rilev/ariaday/ariaweb-new/
			Annual mean temperature (°C)	CITY OF TURIN	°C	14,3	2017	Environmental Data Report ARPA	http://www.regione.piemonte.it/ambiente/aria/rilev/ariaday/ariaweb-new/
				MIRAFIORI SUD	°C	13,4	2017	Environmental Data Report ARPA	http://www.regione.piemonte.it/ambiente/aria/rilev/ariaday/ariaweb-new/
		Soil quality	Concentration of C / Concentration of N/ bulk density / permeability / water retention capability	CITY OF TURIN		Map of Piedmont soils 1: 50.000 scale - IPLA (Unit U0342 - csl2)	2017	Environmental Data Report ARPA	http://www.sistemapiemonte.it/cms/privati/agricoltura/servizi/383-carta-dei-suoli-1-50-000
				MIRAFIORI SUD		No data			
		Water quality	Free O/ Nutrients / Ph / eutrophication level / hydrocarbons / other polluntants	CITY OF TURIN		No data	---		
		Energy Source		MIRAFIORI SUD		Central grid system			
		Urban Waste Mangement	Total urban waste	MIRAFIORI SUD	tons	1,1 million	2018	Amiat Spa Annual report	http://www.comune.torino.it/ambiente/rifiuti/raccolta_diff/raccolta-differenziata-i-risultati-bozza.shtml
			Average household Separate collection	MIRAFIORI SUD	%	51,7%	2018	Amiat Spa Annual report	http://www.comune.torino.it/ambiente/rifiuti/raccolta_diff/raccolta-differenziata-i-risultati-bozza.shtml
			Paper	South Turin	tons	60% recovered 40 ktons of waste	2018	Comieco Annual report	https://www.comieco.org/dati-e-pubblicazioni/risultati/
			Glass	South Turin	tons	50% recovered 35 ktons of waste	2018	Coreve Annual report	https://coreve.it/ricerche-scientifiche/
			Plastic	South Turin	tons	43% recovered 23 ktons of waste	2018	Corepla Annual report	http://www.corepla.it/documentazione
			Organic	South Turin	%	75%	2019	Amiat Spa Annual report	http://www.comune.torino.it/ambiente/rifiuti/raccolta_diff/raccolta-differenziata-i-risultati-bozza.shtml

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Urban Fabric	Urban Metabolism	Urban Waste Mangement	others/ wood/	South Turin		NA			
		Public Transport	Total public transport connetions	MIRAFIORI SUD	lines	9 Tram/bus lines	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		Cycling infras-tructure	Total cycling connetions	MIRAFIORI SUD	km	10km Cycle tracks	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
Demography	General	Population	Total	CITY OF TURIN	persons	871.810	2018	Turin Census	www.comune.torino.it/statistica,
				MIRAFIORI SUD	persons	42.175	2018	Turin Census	www.comune.torino.it/statistica,
			Man	MIRAFIORI SUD	persons	20.144	2018	Turin Census	www.comune.torino.it/statistica,
			Woman	MIRAFIORI SUD	persons	22.031	2018	Turin Census	www.comune.torino.it/statistica,
			Population Age ranges	MIRAFIORI SUD	years	11,7% < 14 years 14,7% 15 - 30 years 12,8% 31 - 40 years 28,7% 41 - 60 years 12,1% 61 - 70 years 19,9% > 70 years	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Average age	MIRAFIORI SUD	years	46	2018	Turin Census	www.comune.torino.it/statistica,
		Population growth rate	Average annual rate of change of population size (%).	CITY OF TURIN	%	-0,47%	2017	Turin Census	www.comune.torino.it/statistica,
				MIRAFIORI SUD	%	-0,86%	2017	Turin Census	www.comune.torino.it/statistica,
		Migration rate	Net number of migrants (immigrants – emigrants) per 1,000 population.	CITY OF TURIN	persons ‰	- 4,84 %	2017	Turin Census	www.comune.torino.it/statistica,
				MIRAFIORI SUD	persons ‰	- 3 59 %	2017	Turin Census	www.comune.torino.it/statistica,
		Diversity statistics	% foreign born residents (if available, for both scales, or) Population by ethnicity	CITY OF TURIN	%	12,22%	2011	Census of the ISTAT	https://www.istat.it/it/archivio/104317#accordions
				MIRAFIORI SUD	%	17,12%	2011	Census of the ISTAT	
	Employment	Work intensity	% employed out of total economically active population (15-64 years of age)	CITY OF TURIN	persons	352044	2011	Census of the ISTAT	https://www.istat.it/it/archivio/104317#accordions
				MIRAFIORI SUD	persons	24779	2011	Census of the ISTAT	
	Education	Educational attainment	Average level of education completed by the 20-64 year-old population	CITY OF TURIN	persons	244189	2011	Census of the ISTAT	https://www.istat.it/it/archivio/104317#accordions
				MIRAFIORI SUD	persons	20114	2011	Census of the ISTAT	
	Health	Incidence of allergic disease	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons	CITY OF TURIN	Hospital admissions	3,542	2015	Turin Census	www.comune.torino.it/statistica,
				MIRAFIORI SUD	Hospital admissions	4,914	2015	Turin Census	www.comune.torino.it/statistica,

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Demography	Health	Health Services	farmacies	MIRAFIORI SUD	buildings	10 units	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
			private facilities		buildings	12 units	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		Health Services	private facilities	MIRAFIORI SUD	buildings	1	2018	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		Life expectancy at birth	Average life expectancy (possibly available at higher levels / regional level)	MIRAFIORI SUD	years	82	2015	Turin Census	www.comune.torino.it/statistica,
	Space	Green space per capita	Sqm of green space / person	CITY OF TURIN	sqm	55	2017	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
				MIRAFIORI SUD	sqm	91	2017	Masterplan GIS City of Turin	http://geoportale.comune.torino.it/web/
		Urban safety – crime	Higlights urban safety	MIRAFIORI SUD		Insecurity perceived in the periurban green areas. Presence of uncovered electric pylons	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			crime	CITY OF TURIN	persons	85,403	2017	Census of the ISTAT	http://dati.istat.it - number of crimes reported by the police to the judicial authority - attached data file extracted from the istat portal on 9 November 2018 at 10:02 utc from i.stat
				MIRAFIORI SUD		NA			
		Mobility	total amount of commuters	MIRAFIORI SUD	persons	7630	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Mobility preferences of population	MIRAFIORI SUD	persons	29,0% 2.247 people Public Transpor 53,0% 4.007 people Car 16,0% 1.241 people On foot 1,6% 121 people Bike 0,2% 14 people Other	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
Economy	Employment	Employment rate	the proportion of employed adults in the working age (20-64 years)	CITY OF TURIN	persons	352044	2011	Census of the ISTAT	https://www.istat.it/it/archi-vio/104317#accordions
				MIRAFIORI SUD	persons	24779	2011	Census of the ISTAT	
		Unemployment rate	the proportion of unemplo-yed adults in the working age (20-64 years)	CITY OF TURIN	persons	28126	2011	Census of the ISTAT	https://www.istat.it/it/archi-vio/104317#accordions
				MIRAFIORI SUD	persons	1982	2011	Census of the ISTAT	

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Economy	Employment	Type of jobs	job typologies	MIRAFIORI SUD	persons	Retail 17,7% Electrical technician 16% Other 12% Electronics wholesale 9% Restaurant 6% Real estate 5% Mortuary services 4% Truck drivrt 4% Construction 3% Metal mechanic 3% Software development 3% technician 2% insurance services 2% business administration 2% courier services repair appliances 1 %	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
	Employment	Employment qualifications	Qualifications	MIRAFIORI SUD	persons	Average skilled employee 23,6% Unemployed 21,7% Unskilled worker 16,7% Qualified worker 15,3% Services employees 13,6% Highly skilled employees 8,3 % military 0,6% farmers 0,3%	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
	Industry	type of enterprises	Total number of enterprises	MIRAFIORI SUD	number companies	2732	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Individual company	MIRAFIORI SUD	number companies	1465	2017	Miraforum	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Limited liability company			442			
			Limited partnerships			276			
			General partnership			211			
			Others			338			
			Subordinate Business		type of companies	Chemicals/ Wood/ Glass / Plastics/ Consultancy / waste management / Metal mechanic production / transport	2015	Business Directory Piedmont Region - Sustainable Development and Qualification Sector of the production system of the territory	Piedmont Region - Sustainable Development and Qualification Sector of the production system of the territory https://www.regione.piemonte.it/web/temi/ambiente-territorio/ambiente/rifiuti/rifiuti-urbani
			Family Business			Retail / Repair electronics / constructions / electronics / restaurants/ real estate / Metal mecanic production		Business Directory Piedmont Region - Sustainable Development and Qualification Sector of the production system of the territory	https://www.regione.piemonte.it/web/temi/ambiente-territorio/ambiente/rifiuti/rifiuti-urbani
		Manufacture sector	Total number of enterprises	MIRAFIORI SUD	companies	130	2019	Unique Environmental Database / Turin Chamber of Commerce	https://www.to.camcom.it/principali-banche-dati-ambientali
			Glass			2			
			Metals			47			
			Electronics			6			
			Wood			3			
			Chemicals			3			
			Textile			1			

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Economy	Industry	Manufacture sector	Consultants ENG	MIRAFIORI SUD	companies	31	2019	Unique Environmental Database / Turin Chamber of Commerce	https://www.to.camcom.it/principa-li-banche-dati-ambientali
			Agriculture			1			
			Food and Beverage			3			
			Construction			2			
			Plastics			3			
		Material INPUT flow Manufactu-re sector	Total input material		tons	no data			
			Glass	MIRAFIORI SUD	material	Glass/Adhesives/ sand steel/aluminium/ Pallets Wood/Plastic Packaging	2019	Unique Environmental Database / Turin Chamber of Commerce	https://www.to.camcom.it/principa-li-banche-dati-ambientali
			Metals			Steel/ Electrical Components/Aluminium/ Pallets/Polish Adhesives/Wood / Plastic pallets			
			Electronics			Steel/Electrical Components Aluminium/Pallets Polish/Adhesives/Wood / Plastic palets			
			Wood			Wood / steel / aluminium/ Pallets Wood/ Plastic Packaging/Wood wax/polish/sand paper			
			Chemicals			Acetones/Resin/Gelcoat Adhesives/Soaps			
			Textile			Leather/Pigments/Wood Tannins/Fabrics /thread			
			Consultants ENG			Food stock canteen/soaps paper			
		Material INPUT flow Manufactu-re sector	Agriculture	MIRAFIORI SUD	material	Seeds /Fertilizers/Pallets wood /Packaging plastic Soaps	2.019	Unique Environmental Database / Turin Chamber of Commerce	https://www.to.camcom.it/principa-li-banche-dati-ambientali
			Construction			Sand / clay/ cement, bricks/ tiles and ceramics Wood/ Wood Pallets Detergents			
			Plastics			Polymers Thermoshape Resines/ Epoxy/Silicones elastomers/ Polyurethane			
		Material OUTPUT flow Manufacture sector	Total output material	MIRAFIORI SUD	tons	no data			
			Glass		material	Parts powder Glass Special steel/aluminium Pallets Wood Plastic Packaging	2019	Unique Environmental Database / Turin Chamber of Commerce	https://www.to.camcom.it/principa-li-banche-dati-ambientali
			Metals			Car parts/metal filings, chips and powders/ Cable / electronic /material absorbents, filter materials Packaging/plastics/paper Wood / Plastic pallets			
			Electronics			metal filings, chips and powders/ Cable / electronic material absorbents, filter materials/Packa-ging/plastics/paper/Wood / Plastic palets			
			Wood			chipping wood / Wood pallets/ varnish/ packaging			
			Chemicals						

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE LINK
Economy	Industry	Material OUTPUT flow Manufacture sector	Textile	MIRAFIORI SUD	material	leather/ Pigments Wood/Tanins/Fabrics /thread	2019	Unique Environmental Database / Turin Chamber of Commerce	https://www.to.camcom.it/principali-banche-dati-ambientali
			Consultants ENG			Organic waste Paper			
			Agriculture			Organic Waste/ Wood Pallets/ Packaging			
			Food and Beverage			Organic waste seed and peels/Pallets woods			
			Construction			mixtures of cement, bricks, tiles and ceramics, Pallets Packaging			
			Plastics			Resines chips /powders Pavements (resines) Packaging of raw material			
	Income	Revenues by household	Average household disposable income	MIRAFIORI SUD	persons	no data			
	Real estate	Current property sale value for residential use	Property value, average, EUR/sqm, for single- and collective housing, sale price	MIRAFIORI SUD	Market value (€/mq)	1.300 - 1.950	2017	erritorial Agency for the habitat	https://wwwt.agenziaentrate.gov.it/servizi/Consultazione/risultato.php
		Current property value for commercial/ industrial/ office use	Property value, average, EUR/sqm, sale price		Market value (€/mq)	700- 1.400	2017	Territorial Agency for the habitat	
Culture	Third sector Third sector	Third sector	total organizations	MIRAFIORI SUD	companies	30	2019	School Observatory , City of Turin / Educational Services Department, H2020 ProGIreg SWOT), Municipality of Turin, CO-City Projects , Mirafiori Foundation, Projects AxTO , Mirafiori Dopo il Mito , Miraforum Report)	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
		Total amount projects	total projects		projects	30			
		type of projects	Culture		%	10			
			Territory		%	26,6			
		type of projects	Education	MIRAFIORI SUD	%	16,6	2019	School Observatory , City of Turin / Educational Services Department, H2020 ProGIreg SWOT), Municipality of Turin, CO-City Projects , Mirafiori Foundation, Projects AxTO , Mirafiori Dopo il Mito , Miraforum Report)	https://www.planetidea.it/allegati/Mirafiori%20in%20Numeri_per%20Mira-Froum%202018.pdf
			Labour and trade		%	13,3			
			Poverty		%	10,2			
			Social Cohesion		%	23,3			
	Sites	Historical Monuments			buildings	2			
		Public Services	Squares , Libraries Community centres Churches Theatres Retirement Home		buildings	27			

Annex II

Atlantis Precinct Data Collection

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE_LINK
Urban Fabric	Infrastruscture	coordinates		CoCT		Latitudine (DMS - degrees, minutes, and seconds)33° 55' 31" South; Longitudine (DMS - degrees, minutes, and seconds) 18° 25' 26" Est	2019	Strategic Development Information and GIS Department (SDI & GIS) CoCT	https://web1.capetown.gov.za/web1/OpenDataPortal/AllDatasets
		Surface area	TOTAL	ATLANTIS	m2	28.840.000			
			Green Surface	ATLANTIS	m2	No data			
			Connectivty space	ATLANTIS	m	31.500	2018	Municipal Spatial Development Framework CoCT	http://resource.capetown.gov.za/documentcentre/Documents/City%20strategies%2C%20plans%20and%20frameworks/Cape%20Town%20Metropolitan%20Spatial%20Development%20Framework_2018-04-25.pdf
			Area of buildings	ATLANTIS	m2	57% 16.405.000 m²			
			Total buildings	ATLANTIS	buildings	No data			
		Non-residential buildings	Total Non-residential buildings	ATLANTIS	buildings	309 UNTIS	2019	Strategic Development Information and GIS Department (SDI & GIS) CoCT	https://web1.capetown.gov.za/web1/OpenDataPortal/AllDatasets
			Commercial	ATLANTIS	buildings	91 UNTIS			
			Industrial	ATLANTIS	buildings	160 UNITS			
			Religiuos	ATLANTIS	buildings	22 untis			
			Accommodation facilities	ATLANTIS	buildings	1 unti			
			Ricreational	ATLANTIS	buildings	5 untis			
			Education	ATLANTIS	buildings	19 untis			
			Public Administrion	ATLANTIS	buildings	11 untis			
		Housing	Formal housing	ATLANTIS	m2	7.760.731 m²			
			informal housing	ATLANTIS	m2	645.937 m²			
		% of green spaces	% of total surface which is destined for green spaces	ATLANTIS		No data			
		% Surface brownfields	% of total surface which is destined for brownfield areas	ATLANTIS	areas	17	2019	Master Plan Atlantis SEZ - ARUP / GreenCape	https://www.greencape.co.za/content/sector/atlantis-sez
	Urban Metabolism	Climate / Meteorological data	Precipitation -Average annual precipitation (mm)	CoCT	mm	544	2019	Strategic Development Information and GIS Department (SDI & GIS) CoCT	https://web1.capetown.gov.za/web1/OpenDataPortal/AllDatasets
			Relative humidity	CoCT	%	67			
			Annual mean temperature (°C)	CoCT	°C	14,3			
		Soil quality	Concentration of C / Concentration of N/ bulk density	CoCT		No data			
		Water quality	Free O/ Nutrients / hydrocarbons / other pollutants	CoCT		Wesfleur Water recyling system	2010	Atlantis Water Resource Management Scheme: - CoCT - Department Water Affairs SA	http://www.artificialrecharge.co.za/casestudies/Atlantis_final_10August2010.pdf
		Energy Source		ATLANTIS		Central grid system and off grid solar panels	2019	Energy Market intelligence Report - The GreenCape	https://www.green-cape.co.za/assets/Uploads/ENERGY-SERVICES-MARKET-INTELLIGENCE-REPORT-FINAL-WEB2.pdf

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE_LINK
Urban Fabric	Urban Metabolism	Urban Waste Mangement	Total urban waste	ATLANTIS		No data			
			Average household Separate collection	ATLANTIS		No data			
			Paper	CoCT		No data			
			Glass	CoCT		No data			
			Plastic	CoCT		No data			
			Organic	CoCT		No data			
			others/ wood/	CoCT		No data			
		Public Transport	Total public transport connetions	CoCT	lines	13 My city bus lines	2018	Municipal Spatial Development Framework CoCT	http://resource.capetown.gov.za/documentcentre/Documents/City%20strategies%2C%20plans%20and%20frameworks/Cape%20Town%20Metro-politan%20Spatial%20Development%20Framework_2018-04-25.pdf
		Cycling infrastructure	Total cycling connetions	CoCT		No data			
Demography	General	Population	Total	CoCT	persons	4,524,111	2018	Census data Statistics South Africa	http://www.statssa.gov.za/?pa-ge_id=3955
				ATLANTIS	persons	70.491	2011		
			Man	ATLANTIS	persons	35.700			
			Woman	ATLANTIS	persons	34.300			
			Population Age ranges	ATLANTIS	years	11,1% 0 - 4 years 17,4% 5 - 14 years 19,5% 15 - 24 years 48,9% 25 - 64 years 3,0% 65 < years			
			Average age	ATLANTIS	years	30			
		Population growth rate	Average annual rate of chan-ge of population size (%).	ATLANTIS	%	2,49%			
		Migration rate	Net number of migrants	ATLANTIS		No data			
		Diversity statistics	Population by ethnicity	ATLANTIS	%	85,0% coloured 12,0% Black-African 0,4% Asian-Indian 1,6% Other 0,1% White	2011		
	Employment	Work intensity	% employed out of total eco-nomically active population (15-64 years of age)	ATLANTIS	persons	20.481			
	Education	Educational attainment	Average level of education completed by the 20-64 year-old population	ATLANTIS	%	17,9% primary school 48,0% secondary school 29,1% matric 3,1% Higher education 2,0% no school			

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE_LINK
Demography	Health	Cause of Death/ chronic diseases	Rate diagnosed cases of the disease	ATLANTIS	Hospital admissions	14,5 % HIV - AIDS 6,8 % Alcoholism 6,5 % Interpersonal Violence 6,3 % Heart disease 6,1% Car accidents 4,5% Respiratory infections 3,6 % Cerebrovascular disease	2014	Western Cape Mortality Profile	https://www.westerncape.gov.za/assets/departments/health/wc2011_mortality_report.pdf
		Health Services	Public Hospitals	ATLANTIS	buildings	3 units			
		Life expectancy at birth	Average life expectancy	CoCT	years	82	2011	Census data Statistics South Africa	http://www.statssa.gov.za/?page_id=3955
	Space	Green space per capita	Sqm of green space / person	CoCT		No data			
		Urban safety – crime	Higlights urban safety	ATLANTIS		Insecurity perceived in the between industrial and residential sector - urban voids-	2018	South African Police	https://www.saps.gov.za/services/crimestats.php
			crime	ATLANTIS	crimes	1617			
		Mobility	total amount of commuters	ATLANTIS	persons	19.928	2018	Municipal Spatial Development Framework CoCT	http://resource.capetown.gov.za/documentcentre/Documents/City%20strategies%2C%20plans%20and%20frameworks/Cape%20Town%20Metropolitan%20Spatial%20Development%20Framework_2018-04-25.pdf
Economy	Employment	Employment rate	the proportion of employed adults in the working age (20-64 years)	ATLANTIS	persons	44,33 % 27.897 Labour Force 22,641 coloured 4,467 Black-African 120 Asian-Indian 618 Other 51 White	2011	Census data Statistics South Africa	http://www.statssa.gov.za/?page_id=3955
		Locally Employed	Average of locally employed versus commuters	ATLANTIS	%	72% Employed Outside Altantis 28% Locally Employed	2019	Atlantis Green economy skills audit 2019 report	https://altgen.com/wp-content/uploads/2019/09/AltGen-GreenCape-Atlantis-Skills-Audit-Report-2019.pdf
		Unemployment rate	the proportion of unemployed adults in the working age (20-64 years)	ATLANTIS	persons	26,58%			
		Type of jobs	job typologies	ATLANTIS	persons	Trade Wholesale 28% Services 26% Manufacture 17% Government 9% Agriculture 7% Trasnport Communication5% Construction 4% Electricity , Gas , Water 3% Mining & Quarring 2% Tourism 2%			
		Employment qualifications	Qualifications	ATLANTIS		No data			
	Industry	type of enterprises	Total number of enterprises	ATLANTIS	number companies	287	2019	CoCt Atlantis Investment Facilitation Office/ Western Cape Industrial Symbiosis Programme (WISP	https://www.greencape.co.za/content/sector/wisp
			Services			91			
			Manufacture			Total 121 SMMEs 101 Large 20			
			SMMEs not manufacture			75			

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE_LINK
Economy	Industry	Manufacture sector	Total number of enterprises	ATLANTIS	companies	121	2019	Western Cape Industrial Symbiosis Programme (WISP Not public data base	https://www.greencape.co.za/content/sector/wisp
			Metals			27			
			Electronics			6			
			Wood			10			
			Chemicals			14			
			Textile			16			
			Boat Builder			4			
			Agriculture			4			
			Food and Beverage			9			
			Construction			13			
			Plastics			19			
		Material INPUT flow Manufacture sector	Total input material	ATLANTIS	tons	No data			
			Metals		materials	Steel/ Electrical Components/Aluminium/ Pallets/Polish Adhesives/Wood / Plastic pallets	2.019	Western Cape Industrial Symbiosis Programme (WISP Not public data base	https://www.greencape.co.za/content/sector/wisp
			Electronics			Steel/Electrical Components Aluminium/Pallets Polish/Adhesives/Wood / Plastic palets			
			Wood			Wood / steel / aluminium Pigments/ Pallets Wood Plastic Packaging/ Wood wax/polish/ sand paper/ Timber			
			Chemicals			Acetones/Resin/Gelcoat Adhesives/Soaps			
			Textile			Acrylic yarn/ Pigments/Polyester fabric/ Tannins/parafin Oils/ microfiber fabric/ Polyester Dacrons PVC bags/ Fibre Glass/Polycotton			
			Boat Builder			Glass fibre woven Polyester resin Plastic Hyperlon /Marine plywood Gelcoat/Stainless steel pipes Plastic Packaging/Acetone Polish			
			Agriculture			Seeds /Fertilizers/Pallets wood /Packaging plastic/ Soaps			
			Food and Beverage			Legumes /Cereal/Flours /Fish /Beef Oils/Wheat/Oats/Sugar/cans Plastic packaging/Pallets wood			
			Construction			mineral sand/ stones/ clay/ cement/ bricks/ tiles and ceramics/ Wood/Wood Pallets			
			Plastics			Polymers Thermoshape Resines/ Epoxy Silicones elastomers Polyurethane			

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE_LINK
Economy		Material OUTPUT flow Manufacture sector	Total OUTPUT material	ATLANTIS	tons	No data			
			Metals		materials	metal filings, chips and powders material absorbents / filter materials / Packaging /plastics/ paper /Sludge/ Wood / Plastic pallets	2.019	Western Cape Industrial Symbiosis Programme (WISP Not public data base	https://www.greencape.co.za/content/sector/wisp
			Electronics			metal filings, chips and powders material absorbents / filter materials / Packaging /plastics/ paper /Sludge/ Wood / Plastic pallets			
			Wood			chipping wood / Wood pallets/ varnish/ packaging			
			Chemicals			Dirty water			
			Textile			leather/ Pigments Wood/Tanins/Fabrics / thread			
			Boat Builder			Fibreglass (GRP) off-cuts Hyperlon sheet off-cuts Marine ply off-cuts Acetone sludge			
			Agriculture			Organic Waste/ Wood Pallets/ Packaging			
			Food and Beverage			Organic waste seed and peels Pallets woods/ Chemicals/sludge paper off-cuts/metals off-cuts cardboard/Plastic packaging			
			Construction			mixtures of cement, bricks, tiles and ceramics, Pallets Packaging			
			Plastics			Resines chips /powders Packaging of raw material			
		Green Companies	Type of green companies	ATLANTIS	companies	Total : 24 Construction material 6 Recycling 6 Biomaterials 5 Renewable Energy 4 Green Appliances 2 Chemicals 1	2.019	Atlantis Green economy skills audit 2019 report	https://altgen.com/wp-content/uploads/2019/09/AltGen-GreenCape-Atlantis-Skills-Audit-Report-2019.pdf
	Income	Revenues by household	Average household disposable income	ATLANTIS	ZAR	3.500	2018	Census data Statistics South Africa	http://www.statssa.gov.za/?page_id=3955
	Real estate	Current property sale value for residential use	Property value, average, EUR/sqm, for single- and collective housing, sale price	ATLANTIS	Market value (ZAR/mq)	RENT R25 /m² average, sale price (R/sqm) SALES R2.000 – R2.500 average price (R/sqm)	2019	Strategic Development Information and GIS Department (SDI & GIS) CoCT	https://web1.capetown.gov.za/web1/OpenDataPortal/AllDatasets
		Current property value for commercial/ industrial/ office use	Property value, average, EUR/sqm, sale price	ATLANTIS	Market value (€/mq)	RENT R 1.33 R/m² average price 1000m² (R/sqm) SALES R 200.000 R/m² average price 1000m² (R/sqm)			

	SUBDOMAIN	INDICATOR	DETAIL	SCALE	UNIT	VALUE	YEAR	SOURCE	SOURCE_LINK
CULTURE	Third sector	Third sector	total organizations	ATLANTIS	organizations	49	2019	CoCt Atlantis Investment Facilitation Office	Not public data base
		Total amount projects	total projects		No data				
		type of organi-zations	Culture	ATLANTIS	organizations	10	2019	CoCt Atlantis Investment Facilitation Office	Not public data base
			Territory			2			
			Education			9			
			Labour and trade			16			
			Poverty			8			
			Social Cohesion			13			
	Sites	Historical Monu-ments	Attractions	ATLANTIS	buildings	1 Sand-dunes	2019	Strategic Development Information and GIS Department (SDI & GIS) CoCT	https://web1.capetown.gov.za/web1/OpenDataPortal/AllDatasets
		Public Services	Community centres Places of worship NGO /NPO Theatres	ATLANTIS	buildings	20			

On the midst of this global pandemic, most governments have demonstrated not ready for the current state of the art. After this global impact, how should look like the next circular economy? We need to optimise our health system capacities to increase our resilience to future shocks, climate inequality an opportunity to rethink our value system. We need to purpose a framework that allows us to be ready for the next catastrophe. Today, Cities play a crucial role are on the frontline of responses to the COVID-19 crisis to implement nation-wide measures. At the same time are the laboratories to reconstruct our economy, providing scenarios of collaboration (top-down & bottom-up) for innovative recovery strategies. COVID-19 accelerated the shift towards a new urban paradigm towards inclusive, green and circular cities. On that view, the framework proposed by this doctoral research becomes more relevant than ever before.

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