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Design for quiet living

A Science and Technology Studies perspective on architecture and noise mitigation policies

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Summary

Environmental noise is gaining increasing attention from both the scientific community and public opinion, as its effects on health and well-being are nowadays well-known. Silence is seen as a good to be preserved and restored, particularly in an urban context, where the pressure of densification often conflicts with the need to protect sensitive receivers from various noise sources.

The role of architects and planners in finding solutions to such conflict has been increasingly acknowledged, and a considerable number of studies on possible solutions has been developed.

Such studies mainly evaluate different design and technical solutions with respect to the reduction in noise levels that can be achieved.Many solutions are tested in the same simplified context (usually virtual or scale models) and knowledge is developed through large quantities of data from repeated experiments in a controlled environment, within the typical paradigm of experimental science and technology.

What remains therefore underresearched is the integration of such solutions within the complexity of real transformation processes, in which many different stakeholders and potentially conflicting requirements are involved.

In order to assess the issue, this work claims, it is necessary to adopt a paradigm that is closer to the one of social sciences and technologies, engaging with close observation of real case-studies, investigating and reconstructing the thick mesh of stakeholders, laws and requirements that influenced the process.

In order to do so, the view provided by Science and Technology Studies (STS) is adopted. Previous literature in the field that focused on architecture design processes, and in particular on the role of codes and metrics, is examined to formulate research questions, shaping the lenses to observe selected case-studies.

Moreover, indications for maps and schemes that can help the investigation and representation of the findings are defined, on the basis of previous studies that tried to answer to the STS request of new “visual vocabularies” to visualize the complexity of design processes.

The case-study of an urban transformation in Turin is then explored through visualizations driven by the research questions and indications derived from the background literature. Visualizations are defined through an iterative process in which data collection, analysis and visualization mutually inform each other.

The visualizations are then tested with respect to their legibility, accuracy in describing the process and agency in enhancing new perspectives on the process, interaction within stakeholders and a hypothesis on the future applicability of the maps. The evaluation is done through a focus group with involved stakeholders, following the *critical proximity* concept.

The visualizations are also tested through their use in the investigation of a project in Utrecht, where outdoor noise mitigation ~~is~~ has been tackled by law since the Eighties. The aim is on one hand to discover what can be learned on noise mitigation solutions and policies in the specific context and on the other hand to test the applicability to different case-studies of the maps developed during the investigation of the Turin case-study.

Results of the case-studies analysis pointed out the relationships between human and non-human actors, policies, documents produced and controversies emerged during the process and modification of the building itself. This allowed to derive empirical evidences supporting what stated by previous literature.

In particular, the conditions under which noise policies can be effective in enrolling designers in the definitions of noise mitigation solutions and their succesfull integration with other requirements were put in light, deriving suggestions for possible future policies modifications. Moreover, it emerged how noise policies and verification modalities can influence the design process as well as be influenced by it, hence supporting the request of a much-needed body of researches that will deepen the understanding of how such actors are involved in real design processes.

The visualizations defined in this study resulted to have a good legibility and efficacy in promoting new perspective on the process by actors involved in it, as well as interactions and clarifications among such actors. They also resulted to be suitable for the application on a different case study from the one for which they were initially designed. They can therefore be considered as a good starting point fo future researches investigating similar cases, although some necessary improvements as well as the need for more interactive visualizations emerged.

Indications for future works and research directions are therefore outlined, as a way to reflect on the potential future scenarios that this work may open, and therefore, ultimately, on its possible value within the research panorama.

Far from presuming to be exhaustive, this work aims to be a very first step in the construction of a *body of knowledge* on the many different contexts in which noise mitigation issues affect urban transformations. It hopes to work as a pilot study for future works adopting a similar perspective, crafting devices to help the construction of such a body of knowledge that will support more informed future choices by involved stakeholders.

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Introduction

An introductory engagement with the thesis

In late spring 2017, the Applied Acoustic group of Politecnico di Torino, of which I was part, was contacted by the Environment Area of the local administration of Turin.

The local office was dealing at the time with a dwelling project in a transformation area in Turin. The project was in a heavily noise-polluted area and was experiencing serious controversies related to the implementation of mitigation solutions. Limited noise mitigation interventions could be carried out on the building at that stage of the process, while interventions on the road itself were coming up against a lot of different issues.

The project was one of the first in the city to experience such complex issues, after the publication of local noise policies in 2010, and local offices were working to find agreement~~s~~ with the private developers on possible mitigation solutions which could allow the achievement of environmental noise levels that could be acceptable for the development of dwellings.

The first idea was to cooperate in finding and testing possible technical and design solutions, providing simulation-based data upon which new decisions could be taken.

However, at the time I was also at the beginning of my PhD at the Department of Architecture and Design of Politecnico di Torino, trying, with the support of my supervisors, to engage in ~~a~~ multidisciplinary research study which could cross the borders of technical acoustics and the complex world of architecture project processes. That is when I discovered the world of Science and Technology Studies, thanks to my supervisor, and decided to try to adopt their perspective to look at environmental noise issues in urban transformations from a new perspective.

In this case, the aim is not anymore to study the performance of specific technical solutions, but rather to approach technology through the lens of social science, in order to understand how the application of specific solutions is influenced by the context, and what can be learned from close observation of real case-studies. How can certain solutions be implemented or not? ~~At~~ In what conditions? With what kind of effects on the project? ~~Which~~ What is the role of noise mitigation policies?

The complex transformation area in the city of Turin became then the starting point for my thesis, which however took a new path with respect to the one hypothesized at first. This thesis is therefore also the account of a personal journey that started from a background in building physics, and in particular in acoustics, and progressively merged with the discovery of new fields of study, thanks also to the openness and support of my supervisors. I hope this can be the first step towards fruitful future works.

Engaging travelling companions to define the research path

As said before, this research is the result of an attempt to assess a topic, which is typically assessed from a technical point of view, from a new perspective. The issue of Environmental noise pollution in contemporary cities is well known and widely studied nowadays. However, the actual implementation of possible solutions in real case studies is quite underresearched, and, this work claims, needs to be observed in order to try to fill the gap between academic research on ideal solutions and the messy world in which such solutions need to work.

The thesis is structured in three parts, framed by this *introduction* and the *conclusions* sections.

PART I sets the theoretical and methodological framework of the work:

Chapter 1 introduces the topic and points out the **gap in research** into which this work aims to fit. The chapter shows how noise pollution has raised ~~to~~ international awareness as an issue for contemporary cities and how it can affect life quality as well as urban transformations. It also addresses the state-of-the-art research on noise mitigation solutions, showing how the integration of solutions within the empirical complexity of real transformation processes is still underresearched.

Chapter 2 sets the literature background that helped the move from laboratory observation of ideal models to close-observation of real case studies. The view, provided by Science and Technology Studies (STS), of architecture as a collective process, resulting from variable networks of different kind of actors, is used to shape the lenses through which to observe the selected case-studies and formulate research questions. Previous studies that have adopted this perspective to focus on the role of codes and metrics in the design process are examined. At the end of the chapter, the **research questions** deriving from the literature review are listed.

Chapter 3 sets the literature background that informed the crafting and testing of visualizations that could help narrate the investigated case studies and answer ~~to~~ the research questions defined in chapter 2- Starting from the STS call for a new "visual vocabulary", the chapter first examines previous studies that have tried to answer ~~to~~ this question through the craft of visual devices, and then explores a possible way of evaluating the performativity of such new visual vocabularies, following the concept of *critical proximity* theorized by Bruno Latour. On the basis of the examined literature, **indications are derived for the data gathering and visualization, as well as for the testing of the crafted visualizations**.

Chapter 4 presents the **methodology followed to collect and analyse** the information on the selected case-studies, and to translate it into visual representations, following the research questions detailed in Chapter 2 and the indications detailed in Chapter 3. The chapter presents the steps made in crafting the visual maps used in the analyses of the selected case studies, together with the issues leading from one step to the other.

PART II focuses on the work conducted on the city of Turin, as "leader city" within the Italian context.

Chapter 5 defines the **normative framework** that influences the urban transformations in the city of Turin with respect to noise mitigation issues. An overview of the laws at national, regional and local level is provided, together with the different steps in which a project passes through acoustic evaluation, due to the mentioned laws.

Chapter 6 focuses on the case-study of an urban transformation in Turin. The case-study is explored through the **use of the maps described in Chapter 4**. The findings are summarized at the end of the chapter, **addressing the research questions defined in Chapter 2**.

Chapter 7 presents the **evaluation of the visualizations** crafted for the Turin case-study presented in Chapter 6. Following the indications of Chapter 3, the evaluation was conducted through a focus group with the involved stakeholders. Outcomes of the meeting have been analysed through qualitative content analysis. The results are used to evaluate the crafted maps, with respect to their legibility, accuracy in representing the process and agency in showing a new perspective on the process and possibilities of future uses of similar maps.

PART III focuses on the testing of the analysis and visualization method on a foreign case-study. The Netherlands have been selected, as outdoor noise mitigation has been tackled by Dutch national legislation since the Eighties and are therefore regarded as a sort of possible "best practice" from the city of Turin.

Chapter 8 presents the **normative framework** that influences urban transformations in the Netherlands, and in particular in the city of Utrecht. An overview of the laws at national, and local level is provided, together with the different steps in which a project passes through acoustic evaluation, due to the mentioned laws.

Chapter 9 focuses on the case-study of a urban transformation in Utrecht. The case-study is explored through the **use of the maps described in Chapter 4**. The aim of the chapter is on one hand to discover what could be learned on the application of noise mitigation solutions and related policies in real processes in the specific context, by answering to the research questions defined in Chapter 2. On the other hand, the aim is to test the applicability of the maps created during the investigation of the Turin case-study on a different case-study in a different context. The findings with respect to both aims are summarized at the end of the chapter.

Finally, the **conclusions** section summarizes **the findings of the work**. It recalls the perspective that emerged on the issue of noise-mitigation policies and measures from close-analysis of selected case-studies. Moreover, it reviews the evaluation of visualization used to map the process and discusses the strength and drawbacks of the methodology. **Indications for future works and research directions** are then outlined on the basis of the findings of the work, as a way to reflect on the potential future scenarios that this work may open, and therefore, ultimately, on its possible value within the research panorama.

For each chapter, an initial overview is provided, while the last Section is dedicated to summing up the content of the chapter and the major findings which will be used in the following parts of the work. In this way, the reader can have an overview of the work by moving through those selected parts of the text, before engaging in an in-depth reading of each chapter.

The thesis is followed by two attachments, namely:

- **Attachment 1**, in which all the maps reported in the thesis are collected again, in order to provide a separate document that can be browsed through independently from the text (or in parallel with it);
- **Attachment 2**, in which all the documents listed in the maps are reported in the original version in which they were retrieved.

In all the work, documents reported in the maps are identified through an acronym that indicates the project in which they were involved as well as the order in time (e.g. T1 indicates the first document in the Turin case-study). The acronyms are reported in the text and in the maps, as well as in Attachment 2, with the aim of providing a reference for the reader that wants to reconstruct the process up to the original documents.

PART I

Chapter 1

1 Setting the scene: noise and the city

Overview

Chapter 1 is dedicated to the introduction of noise pollution as one of the major environmental issues of contemporary cities, and aims to motivate why it has been chosen as focus of the work.

Section 1.1 shows how noise pollution has raised to international awareness in the last decades, in particular in relation to researches on its effects on human health, providing a brief overview of how legislation on unwanted or harmful sounds in cities have become, in their evolution, an element which has an influence on spatial planning.

Section 1.2 addresses the state-of-the-art research on noise mitigation solutions which could be developed by architects and urban designers, showing how such research did not assess the integration of solutions within the empirical complexity of real transformation processes.

1.1 The “modern plague”

At the end of Nineteenth Century, the German physicist Robert Koch stated that “The day will come, when mankind will have to fight noise just as vehemently as cholera and pestilence” (Garcia 2001). It not a coincidence, of course, for such a statement to be pronounced at the end of the century in which the industrial revolution and the urban expansion that followed had strongly modified all the environment in which lots of people lived, including its soundscape (Schafer 1994).

From then on, the soundscape of modernity (Thompson 2002) characterized the cities. As stated by Pinch and Bijsterveld: “The amount of noise has dramatically expanded since the early stages of the industrial revolution. […] Sound is no longer produced only by humans and nature, for machines roar everywhere” (Pinch and Bijsterveld 2012a). Although in the past such new soundscape has been celebrated even as symbol of the new, growing modern city, in opposition to the previous life, *in sordina* (Russolo 1916), during the XX century the awareness on noise-related issues has grown together with the amount and kind of noises that populates our daily lives. Nowadays silence is seen as a precious thing to be preserved and restored, as the soundscape of our cities is gaining increasing attention from both scientific community and public opinion (Wagner 2018; Keegan 2018; D. Owen 2019; Mcmullan 2019).

1.1.1 Norming outdoor noise: from sound to numbers

The problem of environmental noise in cities has been battled since antiquity through laws and provisions, such as the ones that during the Roman Empire forbade carts circulation during night-time, (Douglas 2013), while in Medieval period tried to regulate anthropic and domestic noises (Goines and Hagler 2007), such as the ones produced by farmyard animals (Bijsterveld 2003; Schafer 1994).

Similar kind of legislations lasted until XIX century[1], when industrial and technological development leaded to the production of hundreds of new sounds[2] (Schafer 1994), but also to the development of new noise measuring technologies (Pinch and Bijsterveld 2012a).

It is, as said, between the end of the XIX and the beginning of the XX century that noise, which had constantly grown since the industrial revolution, became a central component of the environmental problems that affect the booming cities (Smilor 1977). This gave rise, in the first half of the XX century, to a new interest towards the issue, which pervades the public opinion in Europe and in North America, through movements and associations[3], campaigns[4], newspapers (Bijsterveld 2003; Mattern 2020)[5] which describes the sounds of the "new mechanical age […] as most nerve-wracking" (Bijsterveld 2003) and "transforming the early-twentieth-century soundscape into a sociomedical problem"[6](Mansell 2017).

In the same period, a long series of disputes around annoying unwanted noises crowded the courts of different European countries, putting in light the need to establish a unified method to objectively assess noise (Douglas 2013). The

[1] See, as an example, the Metropolitan Police Act issued by the Parliament of the United Kingdom in 1839, which contains provisions against noises of sellers or other people and carts in the streets.("Metropolitan Police Act 1839" n.d.)

[2] Schafer, in his seminal book *The Soundscape : Our Sonic Environment and the Tuning of the World,* counterpose the "hi-fi" soundscape of the pre-industrial period to the "lo-fi" soundscape of the contemporary period, and indicates how most legislations in the past was directed towards human voices and activities, before all those sounds were replaced or covered by the industry (Schafer 1994).

[3] The New York Society for the suppression of Unnecessary Noise was founded in 1906 and lobbied for quiet zones around hospitals and national legislations for noise control. Soon after, the German Association for the protection from Noise was founded, advocating for noise dampening pavements and regulation of certain transports and machinery noises (Mattern 2020).

The British Noise Abatement Society, founded by John Connell in 1959, obtained the Noise Abatement Act from the Parliament in 1960, and is still active today.

[5] See for instance the rich bibliography of texts of the time provided in (Bijsterveld 2003)

[6] In that same period of general concern and attention on hygiene and health, the problem of noise protection started to be in contrast with the need for ventilation and fresh air supply in the houses. (McKenzie 1916)

evaluation of environmental noise became therefore part of the scientific and technological effort to regulate and resolve potential problems derived from overcrowding in the cities by trying to define norms of behaviour on the basis of objective science-based criteria (Bijsterveld 2003). In this context, new instruments and standardized units for the assessment and quantification of noise started to be developed. In 1925, the first Noise Survey was conducted in New York city through the use of an audiometer, developed within the Bell industries and based on the comparison of the recorded sounds with a standard sound "of known character and intensity" (Free 1930).

In the same years, Bell industries also developed the decibel, a relative unit of measurement originally used to quantify signal loss in telegraph and telephone circuits[7]. In 1930, Edward Free reported that "general agreement" was being reached on the fact that noises should be measured with some kind of unit that could represent hear sensation as it was logarithmically related to the scale of physically intensities, in order to replicate the response of the human ear to sound pressure variations caused by sound waves in air, and that "The telephone unit of the decibel is of this type and is growing in favour for [a unit which could]measure as noise anything from the neighbor's piano playing to the crash of thunder of the bang of a cannon." (Free 1930). In the same paper, he also put in evidence the presence of new measuring tools which worked through the conversion of sound energy into electrical energy, generally called "phono meters" or "noise meters", that were expected to quickly replace all other instruments[8] (Free 1930). A first attempt of a quantitative noise measurements through a phono meter was held in 1929, when the Noise Abatement Commission in New York city conducted a detailed survey of some areas of the city (Scott 1957), in which "A crew on a specially equipped truck, which had an audiometer as well as a noise meter on board, travelled more than5 00 miles in the city to collect the data."[9] (Bijsterveld 2003).

Soon after, the noise survey started to be spatially represented through maps, such as the "map of loudness" of the city of Charlottensburg (Signorelli 2017), a first attempt to represent the spatial distribution of noise, followed, two decades after, by the maps of Dusseldorf and Celle (Douglas 2013).

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[7] The unit was originally called Transmission Unit (TU). 1 TU was defined such that the number of TUs was ten times the base-10 logarithm of the ratio of measured power to a reference power. The decibel can be defined in the same way. In acoustics, when the decibel is used to measure the sound *power* levels emitted by a source, the level is expressed as $L_w = 10 * log_{10}\left(\frac{W}{W_0}\right)^2$, where the reference power is $W_0 = 10^{-12}$ W. However, the decibel unit can also be used to express a sound *pressure* level that reaches a certain receiver, when a certain source is at work. In this case, the sound pressure level is expressed as $L_p = 10 * log_{10}\left(\frac{p}{p_0}\right)^2$, in which the reference pressure p_0 is 20 μPa = 2 × 10−5 Pa, corresponding to the human auditory threshold. For further explanation on this, see, for instance, (Beranek 1993).

[8] In 1917, la A&T had indeed produced one of the first noise level meters, which, although so bulky that accessories needed to use them were "a strong back or a rolling table". (Beranek 1988), set however the path for further developments in noise measurements.

[9] It is interesting also to note that the survey also investigated which sound sources contributed to the measured noise levels, and traffic noise was already at the top of the list (Bijsterveld 2003).

In the Nineteenth century, therefore, technological and scientific developments gradually led from a "qualitative" legislation based on allowed and forbidden sound sources, to a legislation which had the aim to set decibel-based, quantitative methods (Schafer 1994). In particular, the last decades of the century saw the birth of various national legislations that tackled environmental noise[10], starting to connect it to spatial planning by setting noise limits within specific areas and/or in correspondence of specific receivers, often linked to the typologies of land use. From this moment onward, therefore, the issue of environmental noise will not be only an issue of restriction of specific activities, but it will influence spatial transformation through spatially-set, quantitative limits[11].

1.1.2 Health effects and suggested limit values

Since the concern for noise-related issues that started to interest public opinion in the first half of the twentieth century[12] (Bijsterveld 2003; Mansell 2017), studies

[10] See, by way of example, the list of national regulations reported by Douglas (Douglas 2013). The European union took the first steps with the European Commission Green Paper *Future Noise Policy* (European Commission 1996), to stimulate public discussion on noise pollution, and then produced the main normative instrument in 2002 (*EC. Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 Relating to the Assessment and Management of Environmental Noise.* 2002)

[11] This work focuses on the view of environmental noise as a critical aspect for contemporary cities, especially in night-time. As said in the text, this view is the result of a long process, started between XIX and XX century, within a scientific and cultural climate that saw the city as an organism to be "cured" by the externalities of the economic development (Mattern 2020).
In the decades, noise in the city has proved to be a far more complex issue and the way we listen to our cities has constantly been revised and questioned under multiple aspects, influenced by the evolution of ideas on the relationship between humans and the environment as well as by the evolution of technologies. In the Sixties, the World Soundscape Project, founded by Schafer at Simon Fraser University, challenged the view of noise as an only negative element to be removed and the use of the sound level meter as the only way to listen to the city, introducing the concept of acoustic ecology (Schafer 1994). Soundscape studies have since then evolved in many direction and the concept of acoustic ecology itself has been reinterpreted, questioning, for instance, the anthropocentric vision of Schafer's study, in which the role of citizens was to repair the damaged soundscape they have created, in which "acoustic ecology calls on humans to solve problems created by human interference on the planet" (Droumeva and Jordan 2019) and gradually shifting the work from recording and objective documentation of endangered soundscape towards auscultation practices (Mattern 2020) to discover "fraught relationship" between humans and the environment (Droumeva and Jordan 2019).
Technologies have influenced the construction of the concept of noise (Parikka 2012) as well as the way in which sounds and noises have informed architecture and urban planning (Mattern 2017). Moreover, they condition the way in which we listen to our cities: just as the sound level meter determined our way of listening to urban environments in XX century (Mattern 2020), now the omnipresent sensors of the contemporary "smart cities" on one side are potentially enhancing the control of noise levels through an omnipresent ear ("panacousticon" (Mattern 2020)) while on the other side are providing tools for participative sensing (Offenhuber and Auinger 2019; Nold 2017) and questioning the established noise mapping method by supporting controversies on what should be measured, how and by whom (Offenhuber and Auinger 2019).
However, despite soundscape is in some terms being standardized (International Organization for standardization 2014; International Organization for Standardization 2018), national and local policies are usually the result of the definition of acoustic zoning and limits set on noise levels (Droumeva and Jordan 2019). Therefore, since the aim of this work is to follow real processes and investigate the influence of the laws and policies actually in force, the aspect of environmental noise reduction and noise level measurements will be certainly prevailing. The other multiple aspects of noise and its conception within urban context are out of the scope of this work, although we hope that a similar approach to the topic may be suitable also to uture researches aiming at investigating different possibilities of noise regulations and their influence on urban transformations.

[12] Bijsterviled explains how in the mid- and late 1930s studies contributed to the debate on noise pollution in the modern cities, by trying to objectively measure "the physiological and psychological responses to noise",

that aimed to describe and quantify the relation between noise exposure and different health issues have multiplied[13]. Furthermore, international organizations have repeatedly issued reports and guidelines on the topic (European Environment Agency 2010, 2014) (World Health Organization (WHO) Europe 2009, 2011; World Health Organization (WHO) 2018).

During the years, a considerable amount of evidence has been collected, proving that different kind of health effects are related to environmental noise exposure. The most obvious effect is the auditory one (Basner et al. 2014) which occurs when loud and/or long lasting sounds damage sensitive structures in the inner ear and cause the so-called Noise-Induced Hearing Loss (NIHL). Permanent hearing loss has been linked to long lasting exposure to noise levels beyond 80 dB, which is normally much higher than environmental exposure (World Health Organization (WHO) 2018). However, evidence of the non-auditory effects of environmental noise has been growing in the last years.

The 1999 WHO guidelines already reported effects of noise exposure on health-related issues, such as blood pressure and vasoconstriction (World Health Organization (WHO) 1999). More recent studies have provided evidence which indicates that the exposure to road traffic noise affects the risk of Ischemic Heart Diseases, stroke and diabetes (van Kempen et al. 2018). Although evidence is less certain, environmental noise seems to be also correlated to hypertension (Babisch, Wolfgang; Pershagen et al. 2013; van Kempen et al. 2018; Myoungjin et al. 2019), cognition (Clark and Paunovic 2018a) adverse birth outcomes (Nieuwenhuijsen, Ristovska, and Dadvand 2017), quality of life, wellbeing and mental health (Clark and Paunovic 2018b).

Finally, a recent systematic review of studies conducted predominantly between 2000 and 2015 (Basner 2018) has demonstrated the effects of traffic noise on "objectively measured sleep physiology and on subjectively assessed sleep disturbance (including sleep quality, problems falling asleep, and awakenings during the night)", while epidemiological studies (Jarup et al. 2008) have shown that night-time noise exposure might have worse effects on health than daytime noise exposure. Moderate to high correlations were also found between noise levels and annoyance in a systematic reviews of studies published between 2000 and 2014. (Gusky et al, 2017), showing how noise might interfere with daily activities, feelings, and rest, leading to negative responses and stress-related symptoms (Basner et al. 2014).

On the basis of the above-mentioned findings, the World Health Organization has set recommended threshold levels for the 24 hours noise exposure (L_{den}), above

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with sometimes contradictory results and opinions, intertwining with other contemporary debates (Bijsterveld 2003)

[13] For a comprehensive review on the state of the art of research on health effects of noise pollution, see the Special Issue "WHO Noise and Health Evidence Reviews" of International Journal of Environmental Research and Public Health, which informed the 2018 WHO Environmental Noise Guidelines for the European Region (World Health Organization (WHO) 2018).

which adverse health effects can occur, and the night-time noise exposure (L_{night})[14], above which adverse effects on sleep can occur. In particular, the recommended levels are 53 dB(A) L_{den} and 45 dB(A) L_{night} for traffic noise, which is 10 dB lower than the 55 dB(A) previously set as an interim level (World Health Organization (WHO) Europe 2009), 54 dB(A) L_{den} and 44 dB(A) L_{night} for railway noise, 45 dB(A) L_{den} and 40 dB(A) L_{night} for railway noise.

1.1.3 The cost of environmental noise

The health effects of noise pollution have also an impact in economic terms. In 2011, the World Health Organization (World Health Organization (WHO) Europe 2011) estimated that at least 1 million healthy life years are lost every year in western Europe due to health effects arising from noise exposure. Given that results from systematic literature review (Ryen and Svensson 2015) leaded to the calculation of a trimmed mean of about 74000 euro per each lost year within the identified studies, the high cost of health-impact on noise, can easily be inferred[15]. Harding, Frost, Tan & Tsuchiya (2013), on the basis of national indicators which assume the value of a QALY as precisely 74000 euro, estimated that in one year the effects of noise on health have a cost of 1,34 billion euros in the United Kingdom.

Moreover, noise pollution can impact through other externalities, such as negative impact on market values of properties or costs of productivity losses. Already back in the Nineties, the cost of environmental noise pollution was estimated as being between 0.2% and 2% of GDP in the European countries (European Commission 1996).

Verhoef (Verhoef 1994) estimated a decrease of residential property values of about 0.5% for each dB(A) which is added, for noise levels above 50 dB(A), while Morioka et al (Morioka et al, 1996) found a decrease of land prices of 1-2% per each dB(A) between 51 and 66 dB(A) in Kobe. Dunayevsky (Dunayevsky 2002) showed an almost linear decrease of 1.57% per dB(A) in the dwelling price in Moscow for noise levels between 55 and 75 dB(A) (de Ruiter 2004).

EEA suggested a reduction of house price of 0.2% to 1.5% for each dB(A) of noise level increase (European Environment Agency 2010, 2014).Later studies generally confirmed such values. By way of example, a study conducted in Nantes in 2013 showed noise to exert a significant effect on house prices (Le Boennec and Salladarré 2017), while a study conducted in Naples (Del Giudice and de Paola,

[14] L_{den} ((day-evening-night noise level) and L_{night} (night noise level) are indicators defined by the Environment Noise Directive ((*EC. Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 Relating to the Assessment and Management of Environmental Noise.* 2002) as indicators to quantitfy respectively, noise exposure during the 24 hours, and noise exposure during nighttime (10 PM – 6 AM). For a more complete explanation, see Annex I of the Directive..

[15] Although the WHO report uses the DALY (Disability Adjusted Life Year) instead of the QALY, (Neumann et al. 2018), this can still provide an indication of the “costs” due to years of healthy life loss.

2014) found an average depreciation for real estate values ranges from 0.30% (diurnal emissions) to 0.33% (nocturnal emissions) for each dB of increase in noise levels,. Moreover a research conducted in the Swiss canton of Geneva showed similar values for the rent market, with a decrease of 0.7% in house rent per each dB of increase in noise levels (Baranzini and Ramirez 2005).

1.2 The quest for a treatment

In his book *Cities. An Environmental History*, Ian Douglas highlights the issue of environmental noise as a problem which contemporary cities are called to face. He refers to a "compact city dilemma", noting how compact urban areas that are seen as a possible key to reduce energy and land waste may often conflict with the need to protect sensitive receivers from noise sources and guarantee quiet spaces to inhabitants (Douglas 2013; de Roo 2000). In urban context, where urban space is under increasing pressure of densification, the need for protection against environmental noise and the preservation of quiet areas can be in contrast with the push of urban development (Maag 2017), hence generating "environmental/spatial conflicts" (de Roo 2003).
The role which architects and urban planners may play in environmental noise protection, as an issue that is part of the contemporary city development, has been gaining increasingly acknowledgement in recent years, with the recognition that **"During the planning stages, architects can make significant improvements to the noise levels within a building"** (European Commission 2017). Under the impulse of this increasing awareness, a considerable amount of studies has been recently developed to evaluate the noise reduction that can be achieved through different solutions involving outdoor areas and building design.

1.2.1 Research on mitigation solutions

Research on possible mitigation solutions have assessed the issue investigating the effects of geometries of buildings and outdoor spaces, as well as of different upholstering materials and specific technical solutions[16]. Kang (Kang 2005) assessed the effects on the acoustics of a square in case of different width/length ratio of the square and different heights of the surrounding buildings, while Echevarria Sanchez *et al.* showed how the design of city blocks and road sections can help protecting inhabitants from noise (Echevarria Sanchez, Estevez Mauriz, and Margaritis 2016).

Different researches have moreover focused on how the design of road sections and street furniture can improve noise mitigation (Echevarria Sanchez et al. 2016;

[16] Part of those studies have been developed within European projects and training networks, such as SONORUS training network, within del Marie-Sklodowska Curie Actions founded by the European Commission, and the HOSANNA (HOlistic and Sustainable Abatement of Noise by optimized combinations of Natural and Artificial means) project, as proof of the attention raised by the issue at European level.

Alves et al. 2016) as well as the improvements provided by different façade geometries (Krimm, Techen, and Knaack 2016, 2017), in particular in contrasting the "urban canyon" effect, in which multiple reflections between opposite facades lead to increase in outdoor noise level, exacerbating the noise pollution (Echevarria Sanchez et al. 2016; Badino et al. 2019). The use of sound absorbing façade elements and upholstering has been assessed as well by a good number of researches (Migneron and Potvin 2012; Zuccherini Martello et al. 2015). In particular, the European project HOSANNA led to the development of a consistent body of work for the evaluation of noise reduction provided by the use of green walls and roofs (Puglisi et al. 2013; Van Renterghem et al. 2013; Yang, Kang, and Cheal 2013).

Such researches however, given their aim of experimental evaluation and comparison of different solutions, have been conducted on ideal scenarios and simplified models, aiming to the maximization of performances from the acoustic point of view. **What is still understudied in the academic context, however, is the implementation of such solutions within the design process of buildings that have to answer to many different requests, needs and norms, which are sometimes conflicting.**

Some recent studies are moving towards the integration of mitigation solutions within real projects, either proposing purely technical solutions (Chan et al., 2017), or working on decision models that help to choose the distribution of the built areas at the initial stage of the design process (Gisladottir, A. Kirkegaard 2017). The problem has moreover been assessed through the use of design tools which can be employed by architects at the initial stages of the design process (Williams et al. 2013; Lu et al. 2016); in particular, optimization tools and integrated design systems (Boeykens and Neuckermans 2006; Scheurer 2010), which have been also applied to building facades design, in order to minimize outdoor noise levels (Badino et al. 2019). They are however still models and tools which have been tested on prototypes and virtual models, although reproducing a process which is aware of possible conflicting requirements, e.g. the need to not modify the window area for ventilation and light or to use market-available upholsteries (Badino et al. 2019). Hence they pose themselves, due to the different objective they pursue, out of a real process, in its richness of different stakeholders, norms and law boundaries, conflicting needs.

1.2.2 A need for complexity

De Roo (de Roo 2003), in describing the urban conflict, remarked how, within a compact urban fabric, the basic indication of keeping an appropriate distance between sources and receivers might be a too simplistic strategy to cope with all the concerns related to "urban environmental conflicts" (de Ruiter 2004). These conditions, he claimed, require a "degree of creativity" from both decision makers "who will have to think increasingly in terms of opportunities instead of clear predefined 'ends'"(de Roo 2003), as well as designers, as seen in Section 1.1. This is especially true since the transformation of urban areas involve a lot of stakeholders with different requirements which need to be translated into one project. This is not intended to lower the importance of objectivity and controllability, but rather to underline that a more "interpretative approach" is needed to cope with "intersubjective phenomena that can nevertheless be considered (at a certain level) from an objective perspective and understood and predicted."[17] (de Roo 2003).

In order to develop this approach, this work claims, **it is necessary to engage with the complexity of real case studies, investigating and reconstructing the thick mesh of stakeholders, laws and requirements which influenced the process.** This will lead to build evidence from case studies "that will, over time, establish bodies of knowledge […] for designers and their clients to make more informed preliminary choices", as looking at concrete examples will allow to better understand how codes and proposed solutions worked in influencing social, environmental and technological conditions, while at the same time being influenced by them (Moore and Wilson 2014).

As highlighted in Subsection 1.2.1, academic research in the field of noise mitigation solutions has developed essentially within a paradigm which is typical of experimental science and technology, which "cannot succeed without increasing or heightening what they address, without producing situations where what they address becomes able to do what it could not do in the usual circumstances" (Stengers 2005), and in which knowledge is developed through large quantities of data derived from repeated experiments in a controlled environment (Okasha 2006). In this case the context, the complexity of boundary conditions, is neutralized on purpose[18].

On the other hand, the magmatic complexity (Haraway 2016) is confronted on a daily basis by practitioners, who develop "the richest form of knowledge" (Henderson 2006) in a practice-based learning which is however rarely disseminated and systematically reviewed[19]. As pointed out by de Ruiter, senior consulting engineer since the Seventies, practice requires indeed a pragmatic approach, which is developed under "societal urgency" in which many different problems ask for quick solutions and for the avoidance of new problems (de Ruiter 2004).

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[17] This concept has been expressed similarly by Armando and Durbiano, who in their book talk about a "comprehensive strategy" to be opposed to a "war strategy". This aspect will be further developed further on this in the following chapter.

[18] Although there are of course some exceptions, such as the urban sound planning workshops developed within the SONORUS project (Easteal et al. 2014)which brought together the different stakeholders and city representatives together with the working group of the project in Antwerp, Gotheborg, Brighton& Hove.and Rome, in order to evaluate the measures which could be taken in order to improve the sonic environment of different places, their feasibility and the related economic aspects.

[19] With some exceptions, as in the case of (Hardlooper 2008) in which practitioners reflects on and disseminate previous experiences with the implementations of real mitigation solutions in real projects, however still focusing mainly just on acoustic performances and not on the process which led to such solutions.

This determines the **quick increase of practical experience that is, on the other end, rarely systematized or evaluated**, as “the opportunities for reflection and further analysis often suffer from the urgency of daily problem solving.“

A tentative to cover this gap between academic research and practice-based knowledge may be done by engaging with thick descriptions (Geertz 1973) of real case studies. This means to adopt a paradigm which is more close to the one of social sciences and technology, which “proceed by lessening or lowering what they address, enhancing the weakness, the propensity to submission” (Stengers 2005), or, in other words, without eliminating the context, but instead engaging with it.

In the following chapter, the travelling companions that will help in this shift of perspective are gathered, building the theoretical framework in which this work is set.

Chapter 2

2 Literature background: sociotechnical perspectives on design processes and codes

Overview

Chapter 2 sets the literature background that helped to shape the research questions and define the lenses through which perform the close-observations of the selected case-studies.

Section 2.1 introduces the view of architecture as a product of collective action, and shows how Science and Technology Studies (STS), and in particular Actor-Network-Theory (ANT), have been applied in architecture to describe a project as the result of an evolving network of heterogeneous human and non-human actors.

Section 2.2 focuses on codes as part of the network of actors, showing how researches within the field of STS have put in light the assemblage of factors that influence the application of a specific code. It also presents codes as sociotechnical artefact themselves, which evolve in relation to the complex contingencies presented by real case studies, and are the result of translation of different instances.

Section 2.3 uses the ANT concept of laboratories to introduce the issue of production of "grey knowledge" within laboratories and the need to explore such knowledge in order to enable more informed choices in the future (section 2.3).

Lastly, section 2.4 sums up what presented in the previous sections and lists the research questions.

2.1 The project as a product of collective action

2.1.1 From demiurge to mediator

In the introduction of her book *Architecture. The Story of Practice*, Dana Cuff described how, looking at the San Francisco skyline with the eyes of a novice architecture student, it appeared to her as "the natural manifestation of an architect's work at a drawing board", leading her to think of the evolution and improvement of urban scene as the result of the powerful carrying of architects' intentions and new ideas into practice (Cuff 1991).

Those excerpts vividly describes a view of the architect, as the "heroic form giver" (Bentley 1999), the autonomous designer of the built environment, which stems as a result of his or hers creative talent. This is, as acknowledged by Cuff, the view of "students and much of the public at large", an "innocent vision" which pictures the architects as working in relative isolation in their "artist-like studios", "pursuing at all costs his personal vision in the face of society's mediocrity" (Cuff 1991). It is a vision derived from media representation of the figure of the architect (Cuff 1991) but also, perhaps, from an academic tradition that shaped such vision, as put in light by Habraken, who, after teaching at MIT for many years, indicated how architects are still taught today to think of themselves as "children of Palladio", assuming the model of individual artistic authorship established in the Renaissance (Habraken 2005).

Although the vision provided by Cuff and Habraken relates to US context, in which both authors operate, this particular view of the architect as demiurge creator of the world is not at all limited to that context.

Rob Imrie, who devoted lots of research on the relationship between codes and design practice (Imrie 2007; Imrie and Street 2009, 2011), working chiefly in the UK context, underlined how the dominant tradition of research about architecture design and history "treat buildings as art objects", assuming that the aim of the architect is the "design of aesthetically pleasing forms of poetic spaces", without saying much about social and political context.

Armando and Durbiano, observing the Italian context with the view of scholars as well as practicing architects, pointed out how the model of architect that dominates the media scene, as well as most of the academic discourse, is the one that they call *architetto autore* [=architect-author], born in the Seventies in the Italian universities, and of which architects such as Aldo Rossi, Vittorio Gregotti and Giorgio Grassi are taken an major representatives (Armando and Durbiano 2017). Although this view of the architect as intellectual and theorist that through his projects develop his visions of the world overcomes, in a certain sense, both the models of architect as artist (the "children of Palladio") and of architect as bearer of a specific technical ability[20], it does not overcome the view of architecture as the "natural manifestation" of a single subject at the drawing board (being it an artist, a Prometheus of a new technology or an intellectual author). Thus, it is still based on the conception of a sovereignty of the architect which is constructed on his own values and does not allow for mediation[21].

Nevertheless, in presenting such predominant models, all the above-mentioned authors put in light how they, once put at the test of reality, might result as "naive" (Cuff 1991) and potentially problematic, as they tend to put too much emphasis on the role of artistic inspiration and creative behaviour and on the technologies employed in a building (Imrie 2007), excluding from scholarly consideration a comprehensive study of the "contexts of architecture", such as the rules and norms

[20] a vision which stems from the Enlightment (Moore and Wilson 2014), but which is also brought by the high tech culture of the XX century (Armando and Durbiano 2017)

[21] For a thorough explanation of the concept of *Architetto-autore* , see (Armando and Durbiano 2017), chapter 2.1.

that regulate and influence a design process, or the role of other stakeholders' requirements in shaping the final result.

Such representation risks to be "utterly unrealistic" (Latour and Yaneva 2008), as architecture projects are far from linear, pre-determined procedures. It is rather a delicate balance of forces, as "other people, circumstances, and events intervene to upset the architect's best- laid plans […] Architecture is a dependent discipline" (Till 2009).

The building is therefore the result of a balance of forces and counteractions (Leatherbarrow 2005) and architecture may then be seen as "the least autonomous of all the forms of cultural production […] compelling us to admit to the contingent nature of architecture as a practice" (Frampton 1989), in which the architect is not the deliverer of form and technique, detached by society, but rather the collector of conflicting voices that "makes the best possible social and spatial sense of them." (Till 2009).

The role of architect less as creator of exclusive designs, and more as mediator within complex assemblies of actors (Moore and Wilson 2009), which can seem not particularly original to professionals in architectural practice (Vermaas et al. 2008; Till 2009), is however not so obvious, as briefly pointed out before, in the academic environment.

Four years after the first look at the San Francisco's skyline, after conducting researches in architectural practices, Cuff looked at the same skyline asking herself "who actually had created this scape", acknowledging that what once appeared as the result of the heroic, sole effort of the architect, now "reverberated with so much complex activity" that was difficult to "keep the architect in focus"(Cuff 1991). The buildings of San Francisco were not seen any more as the product of the "exercise of an arcane and privileged aesthetic code" (Till 2009), but rather as the result of "a complexity of socio-institutional and political processes and relations" (Imrie 2007). At the same time, there was the awareness that this view was not taught to architecture students (Cuff 1991), that there is a disconnection between what architects do every day in the office and the dominant academic discourse, which teaches architects to "seek autonomy from normal life" (Moore and Wilson 2014)[22]. Suppressing how contemporary practitioners actually operate in daily practice (Moore and Wilson 2014) can weaken academic discourse, as the discussion around design would be limited to the acknowledgment of the system of values proposed by a certain "author" or another, hence making scientific research and discussion inapplicable to the field. Moreover, by not acknowledging the role of the practice, the academic research would isolate itself from the rest of the world in which the practice is acted (Armando and Durbiano 2017).

On the contrary, the acknowledgment of a different perspective implies that research in architecture can and should be devoted to the world in which the architectural practice operates, in order to construct academic discourses and

[22] See also the work of Rob Imrie, which presents confirmation of this through interviews conducted with many practicing architects (Imrie 2007; Imrie and Street 2009, 2011).

scientific research on it. Within such assumptions. this work aims at investigating design processes by shifting the light from the designer itself to the wide entanglements of requirements, actors, norms, that contributed to define the project process, with a particular focus on noise mitigation policies and solutions.

2.1.2 The project as a sociotechnical artefact

If, as said before, architecture should be interpreted not only as a fine art or the result of the mastering of new technologies (being them building technologies or design ones, such algorithms), but also as the "managerial and highly social" (Moore and Wilson 2014) intertwinement of different professional cultures and technologies[23], then new lenses are needed to read it. Those lenses can come, as argued by different scholars (see, as an example, Moore and Wilson 2014; Latour and Yaneva 2008; Yaneva 2012; Till 2009; Armando and Durbiano 2017; Guy and Karvonen 2011) from history of technology and from science and technology studies (STS), which can help to see the building not only as a symbolic static object (Latour 2008a), but to deploy it as a process, through a pragmatist approach (Yaneva 2012).

Indeed, as explained by Bruno Latour, STS scholars reshaped the materialist tradition, by transforming objects from given matter of facts to processes involving complex and conflicting assemblies of human and non-human actors (Latour 2008a).

The basic assumption behind STS is that science and technology are a highly social activity (Sismondo 2010; Wiebe E. Bijker, Hughes, and Pinch 1989). This means that technological choices are striven by the complex society in which technicians and designers work. Therefore, the attention is shifted from objects themselves to how they are constructed, as "knowledge and artefacts are […] marked by the circumstances of their production" and, in order to make an artefact or technology evolve, it is necessary to "enrol any number of actors, not all of whom may be immediately compatible" (Sismondo 2010)[24].

It is easy to see how this kind of perspective is well-fitting to architecture in order to open the 'black boxes' (Latour 1987) of architectural artefacts and do justice to the multitude of technicians, engineers, politicians (but also tools, laws, documents...) that Dana Cuff glimpsed behind the San Francisco skyline. Considering artefacts as "co-produced" (Sismondo 2010) helps us to locate agency within their system of production (Moore and Wilson 2014), hence stepping away from the view in which the agency is allocated totally to the architect.

Armando and Durbiano (2017) borrowed from STS the "sociotechnical diagram" (Latour 2013) to describe the evolution of an architecture artefact. The diagram shows the evolution of a technical object as a series of "deviations" or

[23] With the conception of technology as "not only a thing, but is also a body of knowledge and a social practice" (Moore and Wilson 2014)

[24] For a detailed explanation of Science and Technology Studies, see (Felt et al. 2017)

modifications of the artefact. Each successful deviation that constitute a step forward in the evolution of the object, is the one that enlarges the associations of entities involved in the project. In other words, a modification in the project that allows to answer to a greater amount of instances and requirements brought in by different actors. The different instances are "translated" (see following Subsection) into a new project that can answer to all of them, hence implying a material modification in the artefact[25].

Figure 2.1 shows the sociotechnical project applied to the evolution of the bicycle (Pinch and Bijker 1989) as presented in Armando and Durbiano (2017). On the vertical axes are reported the *substitutions,* hence the progressive modification of the artefact, while on the horizontal axes are reported the *associations*, hence the progressive inclusion of different instances (for example, as reported by the authors, the passage to a bicycle with two wheels of the same size and the modifications of the bike frame included the instances of bikers with less athletic capabilities, hence enlarging the market, and therefore the possible instances that led to the next deviation, and so on.

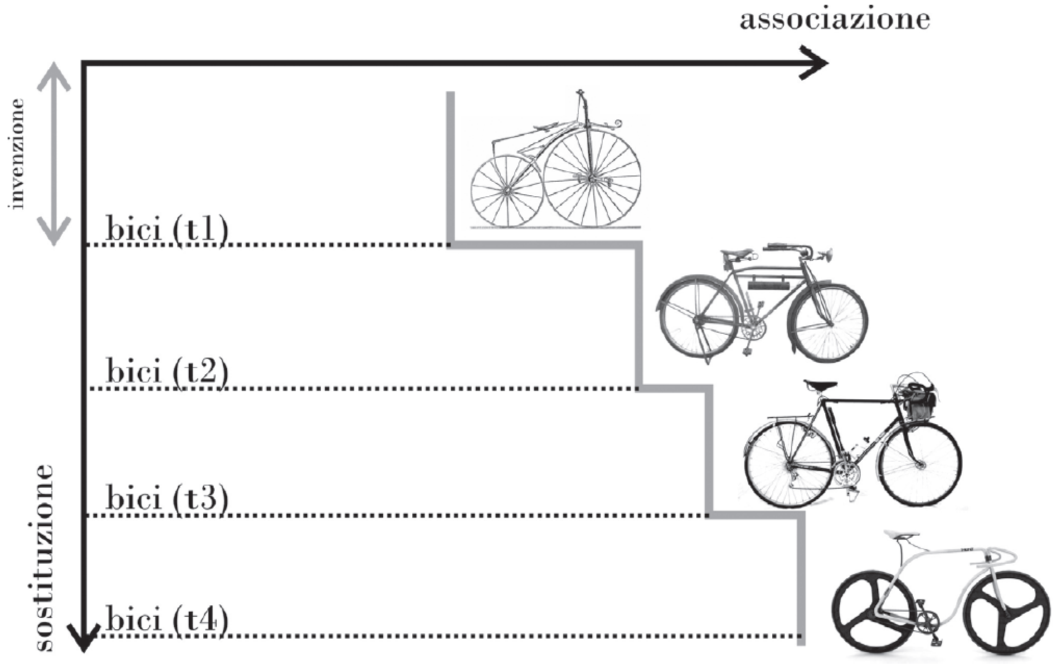


Figure 2.1 - The "sociotechnical diagram" representing the bicycle evolution (Armando and Durbiano 2017)

2.1.3 A network of human and non-human actors

The involvement of different actors, both human and non-human, along the process of development of a technology, and the modification of an artefact

[25] Leatherbarrow (Leatherbarrow 2005) refers to Aristotle's text, *Nichomachean Ethics*, in showing how it already presented a similar view of the evolution of the architecture project, recommending that "when building a house, sketches of basic (configurational) principles should be made in outline form only, so that they can be gradually filled in as unforeseen exigencies and opportunities arise"

resulting as the effort to integrate the different instances brought by them, finds further development in the Actor-Network Theory (ANT), originally developed by Michel Callon (Callon 1986a), Bruno Latour (Latour 1987), and John Law (Law 1987) (see Bruun and Hukkinen 2003; Fountain 1999; Latour 2005b, 2013; Sismondo 2010)

In his book *We have never been modern* (Latour 1993), Bruno Latour argued how the presumed intervention of modern age, "with its ruthless program of purification" (Till 2009) separated and categorized parts, interrupting the "pre-modern" understanding of objects as products and part of complex networks, made of human and non-human, nature, technology and society. Such view did not discriminate any of the parts that compose scientific facts as well as technological objects, as every variable is dependent from others (Sismondo 2010)[26].

By recovering this comprehensive view, it is then possible to conceive a building as one of those objects[27], which are the result of the intersection of a range of different agencies.

The construction and development of such objects is therefore determined by the creation and stabilization of networks composed of heterogeneous actors that contribute to their realization, by combining "isolated parts of the material and social worlds" (Sismondo 2010). Engineers, scientists, designers have to construct networks in order to make their objects successfully reach creation. When a network reach a stability, i.e. when the agencies of all the actors are channelled towards a common goal, a step in the evolution of an object or technology is reached (Latour 1987).

Of course, the stabilization of networks is always temporary, as ever-changing concerns emerge, actors change their goals, while other are brought into the network or left behind. Techno-scientists need to be constantly aware of the mutable array of "dramatically different" actors in order to succeed. The interest of the actors need to be understood and aligned so that their association contribute to a common goal (Sismondo 2010).

This process was defined by Callon and Latour (Callon 1986a; Callon and Latour 1981) as *translation mechanism*, through which actors are enrolled into projects. Latour described this process between different actors as when there is a "translation of their goals which results in a composite goal that is different from the two original goals" (Latour 1999), thus enabling the project to move forward (Bradbury 2016). In this way, agency is distributed and negotiated (Rydin 2013), as the new goal is made possible by the combined action of the enrolled actors.

Inscriptions are often crucial in translation processes, as they commit the achieved agreement between actors to the shared memory of the social system (Sidorova and Sarker 2000). Specifically, in architecture project every translation is usually inscribed in drawings that fix the new transformation of the artifact. It is

[26] In this regard, see Jeremy Till (Till 2009) on the work of Bruno Latour and the related need to break the gap between "pitiful contingencies" and "necessary laws", which bring us back to the need of engaging with contingency.

[27] Defined also as *quasi-objects, hybrid-objects* (Sismondo 2010), *things* (Latour 2005a).

hence easy to see the continuity with the "sociotechnical diagram" presented in the previous Subsection, in which each modification of the process can be seen as the result of the *translation* of one or more new instances into the project.

Previous studies that have assessed architecture within the ANT perspective (Fallan 2011), have put in light, working on real case studies, how it can indeed be found and reconstructed a network of human and non-human actors that evolve during the project (Yaneva 2012; Rydin 2013), showing how the use of specific technologies can mobilize different actors (Linderoth 2010) and how a design process can be described as a succession of translation of different goals, in which the conclusion of a translation leads to a modification in the project (Armando and Durbiano 2017; Bradbury 2016) (these aspects have been further developed in Chapter 3).

In ANT perspective, networks of (human and non-human) actors act as a whole, and therefore it is necessary to study the single parts as well as the whole networks in order to understand their success and failure (Sismondo 2010). Therefore, in order to understand why the buildings evolve as they do, and which solutions were explored, it is necessary to unravel their transformation process, opening the "black boxes" (Latour 1987) to understand why certain technologies were successful or not (Latour 1996). This would help in steering future similar processes, as "solutions are more likely to be successful when they are developed with an awareness of the ways in which contingencies enable and constrain the uptake of such solutions, and of where additional support or regulation might be required" (Lewis 2017).

2.2 Codes and metrics in the design process

2.2.1 Codes within a network of actors

Within the sociotechnical networks of actors that, as seen so far, steer the process and the result of an architectural project, a crucial role is played by different codes, which pose a number of requirements to the building.

Stepping away from the views which see regulations as external from architecture, contrasting forces to which the art of architects whether heroically tries to resist or succumb until the built environment is only but "building regulations turned into brick and mortar", pre-determined by external forces (Imrie 2007), a number of studies tried to focus on how exactly building regulations and design practice interact with each other (Baer 1997; Ben-Joseph 2005; Imrie 2007; Imrie and Street 2011; Lewis 2017, 2015).

Reconnecting to a view of architecture as a dependent discipline, such as the one seen in the previous section[28], Rob Imrie argued that the issue is not to establish

[28] Imrie (Imrie 2007) refers to (Sarfatti-Larson 1993) in speaking of "heteronomy" of architecture

who "matters more" in shaping the built environment, between the creative activity of architecture and regulations. Instead, the issue is to explore how they act in relation to the building design in daily negotiations and disputes about various aspect of the process (Imrie, 2007). He moved therefore again the focus on close observation of situated practices in which the interaction of codes and design can be observed in action, bringing to light also the complex ensemble of factors that interact with them. In particular, in his work he highlighted how different regulations such as the ones on accessibility or energy led to changes in building design. He showed moreover how such changes are often not the result of a direct implementation of the regulation, but rather that it is the complexity of building design processes that defines how regulation are practically implemented (Bradbury 2016).

Other scholars, who have also assessed the integration of particular codes and requirements within the design process with a STS perspective, have supported this view, presenting the assemblage of factors which influence the response to building codes and standards (Guy and Shove 2000; Lewis 2015, 2017; Bradbury 2016).

Alan Lewis applied STS theory to the evaluation of factors affecting compliance to UK guidance on daylight factor, with specific focus on older people's housing (Lewis 2015). He discussed the limitations of previous approaches that have ascribed the non-compliance to guidelines to the lack of awareness of architects, hence falling back to the "creative genius vs stifling rules" paradigm seen before. He claimed instead that a better understanding of how designers are empowered and constrained by the contingencies created by a range of social and economic factors will inform future guidance and practice. Moreover, he underlined how technical solutions alone will fail to improve standards, since designers' actions are shaped by an assembly of social, economic and institutional forces (Lewis 2015). Interviews with practitioners supported this claim, showing that the compliance to daylight factor is heavily affected not only by economic aspects, such as the need to maximize the number of dwellings per floor, but also by other conflicting requirements related to the need of inhabitants (such as the comfortable cleaning of windows and the need to have a protected inner courtyard) and even to aesthetic and common cultural references that pose limits to the windows size in association with predetermined building styles.

The work of Simon Guy focused on energy policies and green buildings (Guy and Shove 2000; Guy and Karvonen 2011; Rydin et al. 2015), showing how the compromises between design teams and regulations shapes the design outcomes (Bradbury 2016), and advocating for a reconnection of technological changes to the context within which a certain design is situated and to its cultural and social practices, in order to develop a "wider range of context-specific responses" (Guy 2010).

Bradbury (Bradbury 2016) used ANT to provide a close look to one specific project process with a focus on energy performance of the building, showing how regulations, including non-energy related one, interact with a wide range of human and non-human actors along the design process, and putting in light the actual effects of the *translations* between those actors on a measurable outcome such as the energy performance of the building. He showed how the gap between the energy performance at the beginning and at the end of the project was due to the need of integrating different requirements along the process, many of which could not be successfully translated without giving up on part of the energy performance, sometimes due to the inflexibility of other regulations and standards. On the other hand, he pointed out how, in the case of energy performance requirement, the flexibility with respect to features of individual elements, as long as the overall performance target is met, allowed to negotiate energy performance of the single elements of the project against other requirements, hence reaching a "true translation" of the different requests. This gave space to the architect as mediator between different requirements, reinforcing the importance of the role as part of the design process.

Bradbury's work also showed how calculation modalities, usually perceived as neutral and objective "black boxes", can indeed influence the process outcomes and suggested that "the way in which regulations are translated into practice is much more complex than is suggested in literature" (Imrie 2007), and that understanding how metrics such as energy performance are shaped by a complex series of requirements will help to reveal ways in which they can be improved.

In such complex and evolving networks, policies can also have the role of intermediaries (Callon 1991). Intermediaries are any kind of actor (inscriptions, artefacts and so on) that passes between two other actors, allowing one of them to involve the other in the network under specific terms (Rydin 2013), hence facilitating a translation of the goals of each of the two into a common one. Rydin (Rydin 2013) presented the case of a low-carbon commercial development in London, in which the planning policy document acted as important intermediary as it brought key human actors in relation with each other, contributing to the delineation of the associations between them and the material elements involved in the process. As pointed out by the author, one of the key aspects of such policy documents was the considerable level of detail, as especially the local ones contained guidance. For example, mayor's Spatial Development Strategy contained indications for the realization of low-carbon buildings, such as heat/space ratio or suggestions for passive solar design. In this case, therefore, the policy allowed to enrol the designer by setting requests to them and better defining the relation between the design of spaces and facilities and the target of low-carbon policies.

In her study, Rydin also underlined how verification methods used to test the compliance to codes, such as energy modelling in her study, often emphasized as black boxes that create incontestable evidence claim, are however often black boxes that are not fully closed, and therefore still open to controversies and negotiation. In such situation, she claims, planners would need the capacity to comprehend and hence challenge such tools for an equal negotiation for reaching better results (Rydin 2013).

2.2.2 Codes as sociotechnical, evolving artefacts

Studies that have assessed the issue of codes within a design process adopting a STS perspective have also pointed out how it is not only the design process and outcome which is steered by codes, but also, in a certain sense, the other way round. Imrie advocated for a view of the relationship between regulators and architecture practice as "recursive or relational", as they are involved in a mutual dialogue (Imrie 2007). In this view, the interpretation that designers do of codes requirements in order to translate them with different goal, as well as contingent problems that impede to translate the norm requirement into the process, can prompt modifications into the norms themselves.

This is, understandably, truer when codes or standards are set at a local level, as direct negotiation between local authorities and practitioners can take place. When there is a "deflection to local control" (Moore and Wilson 2014), therefore, the policies can be more prone to modifications under the push of a contingent situation that leads to define a new *modus operandi* to translate the policies requests, which becomes then consolidated praxis, and so on. This is especially true for leader cities (Moore and Wilson 2014), which are the ones who first develop local policies and then serve as a testing ground to empirically assess them (Moore and Wilson 2014).

Norms and policies (or at least the guidelines and praxis for their implementation) evolve in a series of following steps, just like other artefacts. Like other artefacts, codes are also sociotechnical artefacts (Moore and Wilson 2014), as every modification is the result of a temporary stabilization of a network of actors, whose instances are translated into a common agreement that is inscribed in the norm. Therefore, as the evolution of local policies is a situated practice, which is influenced by the context in which it takes place (Henderson 2006), in order to better understand them and how they influence the design process, it is necessary to pay attention to the complexity of the empirical situation in which regulations take shape (Imrie 2007).

2.3 On laboratories and design strategies

2.3.1 For a "comprehensive strategy"

In his work, Bruno Latour distinguished three kind of laboratories: the *atelier*, the *office* and the *academy*, in which the *atelier* is the place of direct experimentation and production of artefacts and the *office* is "the place where exchanges with the world take place through the development of intellectual technologies" (Ardeth editorial board 2018).

Since, as seen in the previous Subsection, policies are designed as artefacts, it could be assumed that in their design work, being it for a building or a policy, both practitioners' studios and local offices act as what Latour identifies as *ateliers* (Latour 2013).

However the *atelier,* like an artisan workshop, is also the place where practice-based knowledge (Nilsen, Nordström, and Ellström 2012), is produced and cumulated. This is usually a grey knowledge (Iandoli and Zollo 2007; Marzi, Pardelli, and Sassi 2011), which is not shared and discussed in a community. Moreover, it is a "partial" knowledge, developed from a certain perspective, from which the artisan "defends" its own artefact against contrasting forces. As acknowledged by a member of the Environment area of the local administration in the city of Turin,

"There is a situation of asymmetry of information [between local offices and private developers], so that the evaluators [=the technicians of the local offices] are blind towards certain market dynamics, land values, and so on. On the other hand, developers often think that they can ignore environmental requirements and constraints, because of misinformation. Both sides then base themselves on their partial part of knowledge, in the negotiation [...] environmental requirements are often ignored because there is this common belief that it is enough to ask for a piece of paper on the final project, there is not an integrated evaluation process."

Using the words of Erving Goffman, it could be said that actors in their ateliers are entrapped within their frame of interpretation (Goffman 1974). Every actor looks at the project and evaluates it through a different frame and it is unable of "seeing through" other perspectives (Moore and Wilson 2014). Owen and Dovey expressed a very similar concept by referring to Bourdieu's fields of cultural production (Bourdieau 1993) and underlining how in architecture there are overlapping or competing fields of cultural production, which derive from different kinds of knowledge and lead to play different games in the same field (Owen and Dovey 2008), in which "the advocates of art bring out one knowledge to support their claims, and, correspondingly, the advocates of technology bring out another kind of knowledge in support of theirs" (Moore and Wilson 2009).

Armando and Durbiano referred to this way of acting as a warlike strategy, in which the artefact produced inside the atelier is intended as expert and original product, to be defended against external conditioning, hence not open to modification or inclusion of different instances (Armando and Durbiano 2017). However, it has been pointed out how both policies and projects are necessarily shaped by the instances they need to integrate during their evolution. The warlike strategy tend to ignore such necessary evolution, hence clashing against the conflicting requirements brought into the project by involved actors.

As an alternative to this, the authors proposed a comprehensive strategy, in which the collective of actor is enlarged at the beginning of the process, while the project is ready to include as many instances as possible by translating them into the design before it is stabilized by any official inscription. Previewing such possible implication augments the possibility of the project to be effective, hence to reach its realization with a minimum amount of deviations.

2.3.2 Inscriptions as tools for work and exchange

In proposing the shift to a more effective, comprehensive strategy, Armando and Durbiano underlined how this strategy implies the possibility to visually represent within a map all the implication and instances through which the project will have to move (Armando and Durbiano 2017).

Similar kind of maps would constitute a very different representation with respect to the drawings we are used to see in the architecture field. On the other hand, if the laboratories of practitioners have to be intended not only as *ateliers,* but also as *offices*, in which inscriptions are produced (Latour 1987, n.d.) as intellectual technologies to allow an exchange with the world (Ardeth editorial board 2018; Armando and Durbiano 2017), then such intellectual technologies may also be intended as visualizations that map the trajectories of the project, supporting a more effective integration of the different field of cultural production gathering around and architecture project.

As highlighted by Henderson (Henderson 1991), one of the biggest challenges in dealing with complex technical situations is making visible the important entanglements and dependencies.

In Chapter 1 it has been claimed for the need to perform close observation of real case studies in order to understand how policies and technical solutions interact with the project and are translated into it, in order to develop a "body of knowledge" on the field. Here, it is claimed that the effort of researchers and designers, in order to support practitioners and policy makers, should be devoted also to translate the gathered evidences from such body of knowledge into new visual vocabularies. This will help to establish shared ways to map their evolution, showing possible paths for similar processes in the future.

2.4 Summing up and detailing the research questions

To sum up, this chapter has put in light how an architecture project can be seen as **a sociotechnical artefact that evolves in successive steps**, which are the result of translation of goals of different actors into a shared solution. In this perspective, the project is **the result of the agency of a network of human and non-human actors**, in which the architect acts more as a mediator within a complex collective rather than an artist creating in isolation. Actors are indeed usually involved in concerns that close when a common solution is found and therefore a new step in the process is set.

Within this network, **important non-human actors are the codes and metrics** to which the building have to respond. Such codes **can also act as intermediaries between stakeholders involved in the project**, providing guidance for the translation of different goals within a common one. Moreover**, the codes themselves can be seen as sociotechnical artefacts that evolve under the push of complex situations** derived from real case studies and are the result of the need to balance between sometime conflicting instances.

Finally, **verification methods** used to test the compliance to codes, usually perceived as neutral and objective "black boxes", are however often **open to controversies and negotiation** that can influence the process outcomes

However, all those different aspects, put in light by the application of STS studies on architecture, have **never been studied with respect to the issue of environmental noise pollution,** the related codes, and its influence on the project process. Although sound and the contemporary soundscape has been assessed by important STS scholars (Pinch and Bijsterveld 2012b; Thompson 2002; Bijsterveld 2003) it has never been assessed from the point of view of the relation between norms and project process, as done for other aspects of the architecture process in the above-mentioned studies.

Therefore, drawing from the literature presented in this chapter, the following research questions can be defined to investigate the environmental noise issue in architecture processes through close observation of real case studies:

Concerns and involved actors

What are the arising concerns?

Which are the actors involved?

Translation into common goals

When are noise mitigation goals successfully *translated* with other goals? When not?

Which kind of actors are involved in the successful or failed translation?

Which are the intermediaries acting in such translations?

Policies

When and how do local and national policies act? Is there a "deflection to local control"?

Do the policies work as "intermediaries" ?

Are the tools used to verify compliance with policies already "black boxed"? What can be learned on their functioning?

Is there a "relational matrix" between architecture projects and norms?

If so, which are the (human and non-human) actors involved in the definition of the norm?

Lastly, it has been underlined how much effort should also be devoted to the development of visual vocabularies to represent the investigated processes in a way that is useful to make it readable and to make the answers to the previous questions visible. The following chapter will focus on the literature background that will help to direct the crafting and testing of such visualizations.

Figure 2.2 show a **schematic synthesis of the literature background** presented in the chapter. Key concepts are presented, together with the connections between them that allowed to construct the discourse that led to research questions and to the connection with the following chapter. For each concept, the main literature references are reported in blue.

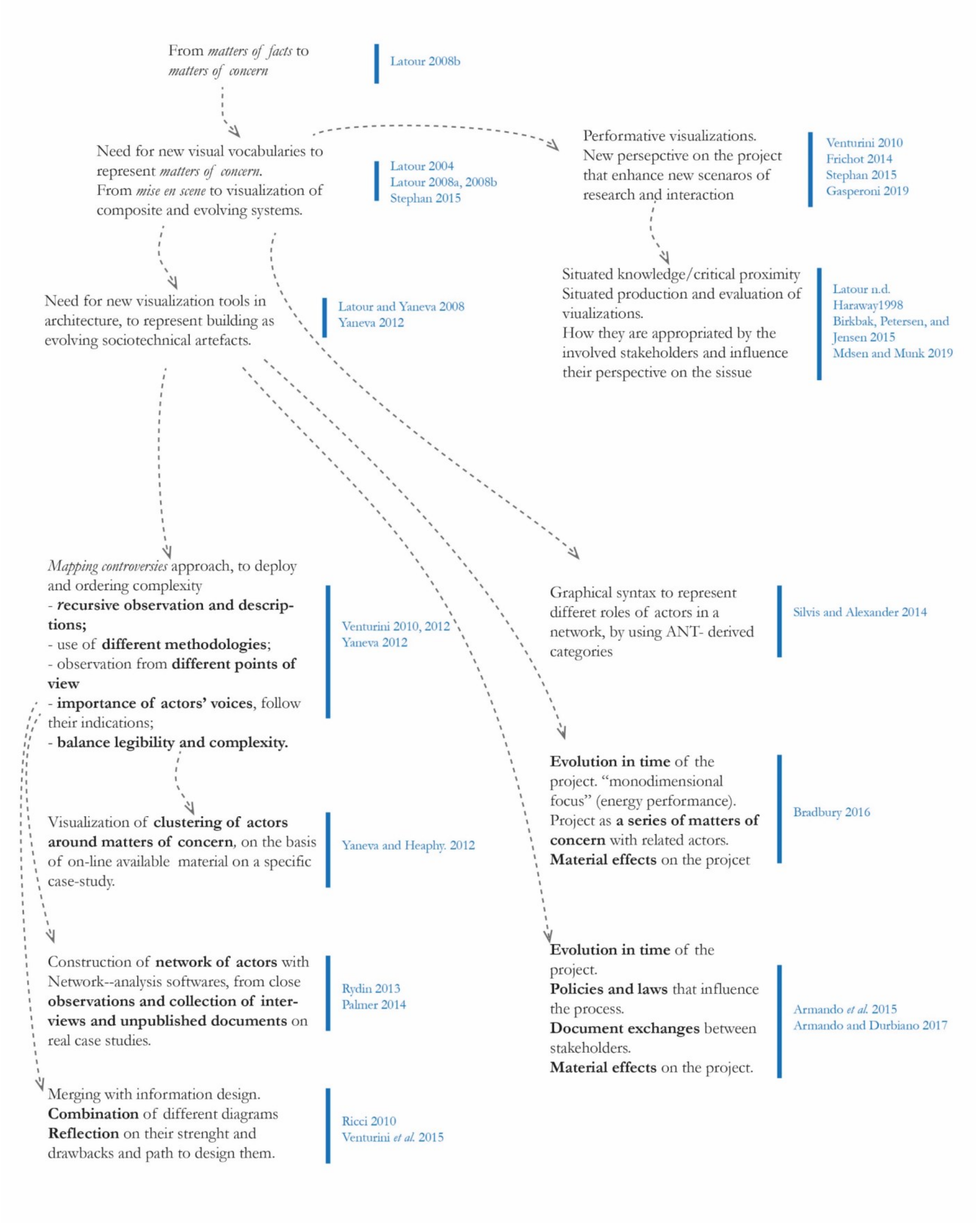


Figure 2.2 – Visual summary of the literature background presented in Chapter 2

Chapter 3

3 Literature background: visualize the complexity

Overview

Chapter 3 presents the literature background that informed my research with respect to the crafting and testing of a new visual vocabulary.

Section 3.1 focuses on indications which can be derived from literature on how to craft such visual devices, including some previous mapping attempts that have worked on visualization of processes within the architecture and urban design field, most of which are based on theoretical frameworks provided by STS and ANT.

Section 3.2 addresses the issue of how to test the designed visualizations in order to assess whether they are capable of modifying the understanding of a process. In particular, the concept of *critical proximity* proposed by Bruno Latour is presented as the theoretical basis which supported the choice of testing, in the present dissertation, the visualization through meetings with stakeholders involved in the process itself, whose results will be presented further on in the thesis.

Section 3.3 sums up the indications that are derived from the above-mentioned literature and that will be used in the crafting of maps presented in the following chapters.

3.1 A new visual vocabulary

3.1.1 "Where do you place the angry client?": visualising matters of concern

As seen in Chapter 2, the perspective on architecture brought by STS claims for a view of buildings as evolving objects, resulting from the balancing of agencies and requirements of different human and non-human actors. The chapter also briefly introduced how this perspective calls for new visualizations, which should be traced in order to preview and facilitate the translation of different instances.

A new perspective on architecture project will call for new ways of representing and describing it. The process cannot be understood by only representing the final outcomes as "solidified" in the building, but there is the need to find a way to represent the failed or successful translation that led to such modifications, and the rich world of actors gathered around them.

Everybody knows that a building is an evolving project rather than a static object (Latour and Yaneva 2008; Yaneva and Heaphy 2012), however the visualizations traditionally produced in architectural design look "desperately static" while the need is, instead, to define new devices able to reshape the view of a building from a static object to the evolving flow that it really is (Latour and Yaneva 2008).

Having recognized that a building is a "contested territory" does not make researchers and designers less unable to represent the controversies and complex networks of actors involved in the same way as they are able to represent the object resulting from them. There is a lack of a visual vocabulary to express the richness of controversies, debates, gathering of actors which leaded to the stabilization of a certain building design in the same way as the design itself is expressed, making it visible and disseminating it. There is a "paradoxical discrepancy" (Latour and Yaneva, 2008) between what is known –especially by practitioners –about what a building is and how it is represented, as in usual architectural representations there is no place for the angry client, the various stakeholders and their conflicting demands, the normative constraints and the many successive modifications that were defined in order to respond to all the requirements (Latour and Yaneva 2008). In other words "How can steel, wind, high construction and the worlds that humans shared with them to shape this building be presented together on a drawing?" (Yaneva 2012).

Although the term "mapping" is widespread in STS studies (Yaneva 2012), as a field that advocates for a vision of the world as made of entanglements, limited media have been produced since now to capture those reach entanglements that put together the social, the cultural, and the technological of which a building is made (Yaneva 2012).

In a keynote lecture addressed to the Design History Society, raising a sort of provocative request to designers, Bruno Latour underlined how **design disciplines have developed insofar methods for visualising objects as *matters of fact*** (Latour 2008a). Matter of facts are real, static objects, on which enquiry and critique has much focalized in the past (Latour 2004), in a narrative of "detachment, modernization [and] progress" (Latour 2008a). However, all objects are the result of an evolving gathering of actors with different instances and requirements, or, in Latour's words, "all matters of fact require, in order to exist, a bewildering variety of matters of concern"(Latour 2004)[29].

Designers are called to craft tools to design *matter of concern*, engaging with this different narrative of "attachment […] entanglement [and] dependence" (Latour 2008a), to "reconnect scientific objects with their aura, their crown, their web of associations" (Latour, 2004) in order to better understand how they evolved. The challenge is therefore to provide for matters of concern, a visual, publicly

[29] Latour draws a distinction between objects and but things (Latour 2008a), or rather Dinge, are gatherings, drawing from Heidegger (Latour 2004, 2005a).

inspectable space that is as easy to handle and codified as what has been done over centuries for objects conceived of as matters of fact (Latour 2008a).

Building on the definition of matter of concern as "what happens to a matter of fact when […] shifting your attention from the stage to the whole machinery of a theatre" (Latour 2008b), Stephan underlines how for designers "The visualisation task is to map all of the stakeholders' perspectives that together constitute the complex socio-technical machinery of a theatre, including political institutions, financial flows, working conditions, buildings, infrastructure, tourism, ticketing, and so on" (Stephan 2015), a cosmogram[30] of "an infinity of relations that extend far beyond its visible material form, grasped in space and time" (Yaneva 2012).

In opposition to representations of architecture which "ruthless edit[..] the contingent. Out of sight, out of mind" (Till 2009)[31], the context must be brought back into the representation. It does not stink (Latour 2005b), as it is not limited to the fixed scenography of the theatre (Stephan 2015), but is rather a world whose entities must be taken into account when exploring the complex compositions that constitute buildings, since the beginning of the project (Latour and Yaneva 2008; Yaneva 2012).

The designer's traditional task of *mise en scène* of artefacts is therefore replaced by a new task of visualization of composite and evolving sociotechnical systems in which stakeholders take contentious positions (Stephan 2015). By **investing designers and researchers' knowledge and efforts in creating grounded, realistic accounts of architecture design processes**, tracing the complex assemblies of actors in the specific space and time in which they are situated, instead of referring to "abstract theoretical frameworks outside architecture", architectural theory will get out of the ivory tower from where it is perceived to be[32] and instead become a relevant field for architects, for end users, for promoters, and for builders (Latour and Yaneva 2008).

3.1.2 The *mapping controversies* approach and what can be learned from it

The quest for new visual vocabularies within the ANT- based studies found a practical development in the *mapping controversies* approach, initially developed by Latour at the *École des Mines de Paris* (Venturini 2010) as a "teaching philosophy" for inquiries based on ANT (Yaneva 2012), and now taught in different European and American universities (Venturini 2010; Yaneva 2012)[33].

30 See John Tresch (Tresch 2007) on cosmograms

31 See Till (Till 2009) on the works of Edmund Bacon

32 See Till (Till 2009), where in the first chapter tellingly titled *Deluded detachment*, is presented a description of how the Sheffield university Arts Tower can be seen as a physical embodiment of such conception

33 See the introduction to the *mapping controversies* approach in (Yaneva 2012) and in (Venturini 2010).

As indicated by Venturini, *mapping controversies* approach consists in the crafting of devices to investigate and describe controversies linked particularly, although not exclusively, to techno-scientific issues. It shares the same principles of ANT (see Subsection 2.1.3), to which it is linked by a relation which can be exemplified as the one that links a "learning by doing" methodology to a theoretical manual (Venturini 2010).

With the term "controversy" scholars in the field refer to topics of conflict and negotiation around which different actors gather, similarly to the concept of *matter of concern*, which end when they manage to stabilize a solid compromise (Venturini, 2010) that is then black-boxed into a defined object.

The previous chapter introduced how controversies are integral to many aspects of architecture practice (Yaneva 2012). Just like in techno-scientific debates, design debates open up black boxes, allowing to understand the production of buildings and objects that otherwise will be taken for granted. as shown by Yaneva (Yaneva 2012; Yaneva and Heaphy 2012) on iconic buildings such as the Eiffel Tower and the Sidney Opera House, unravelling "the rather messy history of [their] design controversies" (Yaneva 2012).

Under this perspective, architects need to engage with a pragmatist, empirical "programme of inquiry" (Yaneva 2012). The controversy mapping approach proposes a situation-based, out-of-the-studio inquiry *about* architecture[34] and its various entanglements, which can nevertheless be conducted only "as far as our analytic and visual tools will allow us" (Yaneva 2012), hence challenging designers to conduct researches on two parallel fronts that mutually feed each other: on one side, to explore the land of design quarrels which opens up behind an apparently stabilized object, while on the other side continuously developing maps that support the exploration and allow to organize findings and direct further steps.

Controversy mapping researchers have developed some principles to guide the double task "of *deploying the complexity* of controversies [and] of *ordering the complexity*" (Venturini, 2010). Following the points defined by Venturini (Venturini 2012), this Subsection tries to **underline the aspect of the methodology which have informed the work** that will be presented in the following chapters.

Adjust your descriptions and observations recursively

Similarly to the work of cartographers, this "out of the studio" inquiry in unknown lands requires to develop maps of the explored territories that will be refined during the search. **The researcher will therefore not deploy the maps after the phase of data gathering, but rather simultaneously, in a recursive refinement of investigation and description** (Venturini 2012). Data and maps will inform each other, leading the researcher to explore and craft visual strategies to

[34] See Yaneva (Yaneva 2012) on the contraposition between this way of learning and the within.the-studio reflection of Schon's reflective practitioner.

“deploy with design virtuosity the ontological charade they find when studying a controversy” (Yaneva 2012).

Do not restrict your observation to any single theory or methodology

In his 2010 work on cartography of controversies, Venturini reports that Bruno Latour, when asked on how to conduct a cartography of a controversy, would answer “just look at controversies and tell what you see” (Venturini 2010). This methodological freedom (which might work as a double-edged sword for researchers) does not mean however that controversy cartographers deny the validity of other consolidated and previously developed methodologies. On the contrary, they can use “every tool at hand“ (Venturini 2010), **taking bits of different methodologies and even mixing them**, when reasonably needed, being open, at least at the beginning, to test different kinds of observation and visualization tools[35].

Observe from as many viewpoints as possible

The same open attitude devoted to methods should be kept also with respect to sources. The researcher will be more capable of grasping the richness of a process the more (s)he accumulates a richness of different sources (Venturini 2010). Although the approach usually looks to public debates, on which many sources can be found on the web, and the tools developed to map them are often based on automated web-searches[36], the same approach has been **applied also to documents collected through archives, interviews and fieldwork** (see for instance, (Bradbury 2016; Rydin 2013), as, especially in design and building processes of less-known buildings, many information are exchanged in documents and communications between practitioners, and are not treated in the public digital arena.

Listen to actors’ voices more than to your own presumptions

As previously said, the observed processes involve different stakeholder that deal with the issue at stake on a daily basis. On the contrary, the researcher observes the phenomenon for a limited amount of time and has an external point of view. Therefore, the approach of cartography of controversies requires to researchers to **trust the voices of these stakeholders, which may work as gate-keepers** (Lewin 1947; White 1950) **who lead the researcher into the complex reality**, providing valuable observation points from which to explore the territory and decide how to

[35] Such freedom in drawing upon different methodologies has also lead to sometimes different interpretations and views on how different methodologies can be seen in relation to ANT-based research. By way of example, Grounded Theory (Glaser and Strauss 1967) has been seen either as a way to provide a structured framework to conduct ANT-based studies (Kraal 2007; Zimmermann 2008) or as a too structured framework which is in opposition to the methodological freedom of ANT-based research (Wright 2016).

[36] See for instance the wide list of tools provided on the Macospol website (http://tools.medialab.sciences-po.fr/)

proceed. Such viewpoints are of course never unbiased. Some of them may offer a wider view of the landscape (Venturini 2010), but a more unbiased view can be obtained only by seeking for a "second degree objectivity" (Venturini 2012) by multiplying the observation points, hence entering into the controversy from the point of view of different stakeholders.

Simplify complexity respectfully

This point refers to the difficult task of **balancing the need to render a readable description of the controversy with the need to narrate its complexity**[37]. This is true in particular in the perspective of addressing a public outside the academic community (Venturini 2012). To avoid a visualization that overloads the cognitive capacity of the reader and is therefore counterproductive, calls for a structure and an effort to develop visual standards (Stephan 2015). Although there are of course no fixed guidelines to simplification, one good advice should be to define the maps in order to visualize different layers of the controversy, much like different levels of magnification in a microscope (Venturini 2010), while keeping reversibility, i.e. the possibility to climbing back the steps that leaded from the sources to the different maps (Venturini 2012).

3.1.3 Some inspirational visualization attempts

Besides following general advices, valuable suggestions on how to proceed in the crafting of a visual device, in the wide landscape of possibilities left by ANT methodological freedom, can be retrieved from previous studies which have engaged with such challenge, especially within the architecture and design research.

Within the mapping controversies approach, the core of studies on architecture-related controversies and processes has been developed by professor Albena Yaneva at Manchester University. In her book, tellingly titled *Mapping controversies in Architecture* (Yaneva 2012), Yaneva presented a series of cases in which iconic buildings are un-black boxed and presented as networks of actors (see Figure 3.1a).

In the representation of the controversies developed around the project of the 2012 London Olympic Stadium, Yaneva and Heaphy (Yaneva and Heaphy 2012) worked on the manifestation of the controversy in the media and on publicly available documents found on websites of official organizations, from which they extracted the list of human and non-human actors involved, as well as the matter of concern around which they gathered. Through the cooperation with the R&D of a design firm, the data were then translated, through post-parametric computational tools, into interactive maps **showing the evolution of clusters of actors around**

[37] Venturini refers to the map-territory relation in Borges' *On the exactitude of science* (Borges, 1946), in stating that "nothing is vainer than a map tracing its territory point by point" (Venturini 2012)

different *matters of concern* in time, hence focusing on the process as series of matter of concern developing in time (see Figure 3.1b).

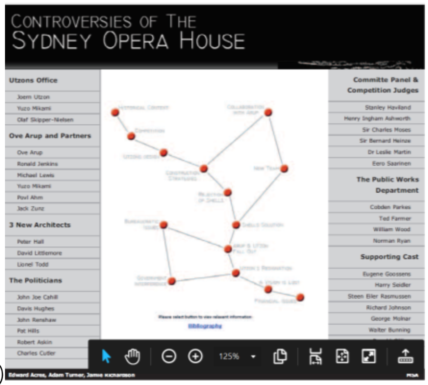
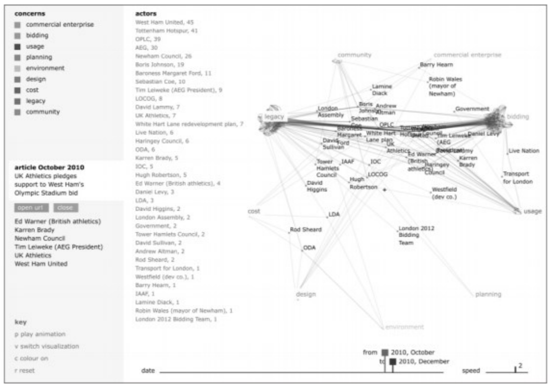
(a)  (b) 

Figure 3.1 - (a) Network of actors involved in the design of the Sydney Opera House (Yaneva 2012); (b) Network of actors involved in the controversies on the London Olympic Stadium (Yaneva and Heaphy 2012)

Other studies have then applied similar methodologies to **the studies of less-known cases**. In such studies, the pool of data in not retrieved from web-published material, but the *hybrid forum* (Callon, Lascoumes, and Barthe 2009) of actors gathering around the development of specific buildings is reconstructed by the researcher **through the use of interviews, documents and field-work** and representing it in **networks of actors produced through the support of different software.**

Rydin worked on the case of a commercial office development in central London, collecting data through "document analysis, a site visit and discussions with British Land's sustainability officer, two architects from Arup Associates and the developer's planning consultant" (Rydin 2013).

Through close reading of the material, based on ANT concepts, the author derived the list of (human and non-human) actors involved in the process, as well as the connections between different actors. Such relationships were then translated, through the use of a social network analysis software[38], into a network in which the nodes are constituted by the actors (see Figure 3.2a).

Palmer performed a similar work on the building system of medium density housing in Australia, working on data derived from "a variety of sources including existing literature, texts, and semi-structured interviews with key industry stakeholders" (Palmer 2014). In this case, connections between (human and non-human) actors have also been ranked into 4 different degree of strength, established by the author according to the level of impact on the design outcome. ANT-based concept such as actors working as mediators, focal actors or obligatory passage

38 Softwares such as UNCINET (https://sites.google.com/site/ucinetsoftware/home), Gephy (https://gephi.org/), NodeXL (https://www.smrfoundation.org/nodexl/), etc.., normally used to derive network representations from automatic extraction of web available data, such as social network pages, tweets, etc., can also be used to build such representations from nodes and connections which are manually set by the researches, as in this case.

points (Callon 1986b) have been identified on the basis of the positioning in the network and the number of out- and in-coming connections (see Figure 3.2b)

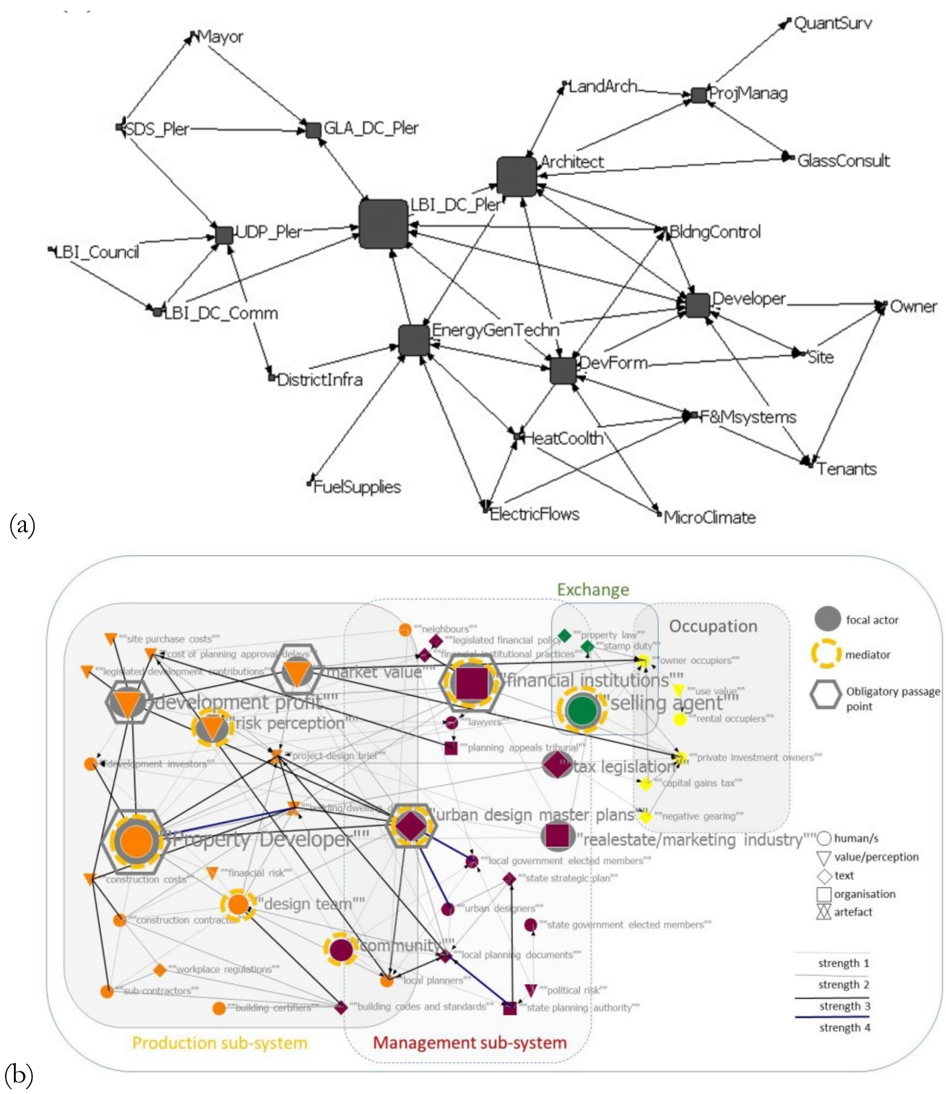


Figure 3.2 - a) Network of actors in (Rydin 2013). Nodes are sized by their degree of betweenness; (b) Network of actors in (Palmer 2014), with indication of the different categories of actors

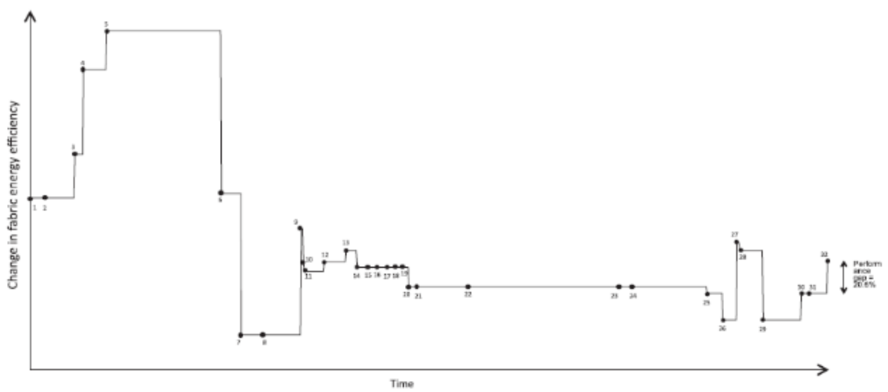
Some studies (not necessarily dealing with architecture design issues) have also tried to further develop the **network organization through the use of ANT-derived concepts to represent actors according to the role played in specific processes**.

Silvis and Alexander (Silvis and Alexander 2014), observing and representing the development and implementation of an electronic healthcare record system, developed a “graphical syntax for actor-network theory”, in which different graphic codes are used to represent actors which have different roles in the network. The different type of roles are derived from ANT-based concepts. Categories of actors are therefore established “a priori” and deductively applied in the analysis of the specific case. As far as time is concerned, similarly in some way to what is done by Yaneva and Heaply (Yaneva and Heaphy 2012), the authors developed different maps for different moments of the process, using the encounter-episode framework derived from Newman and Robey (Newman and Robey 1992) and developing a map for each encounter or episode.

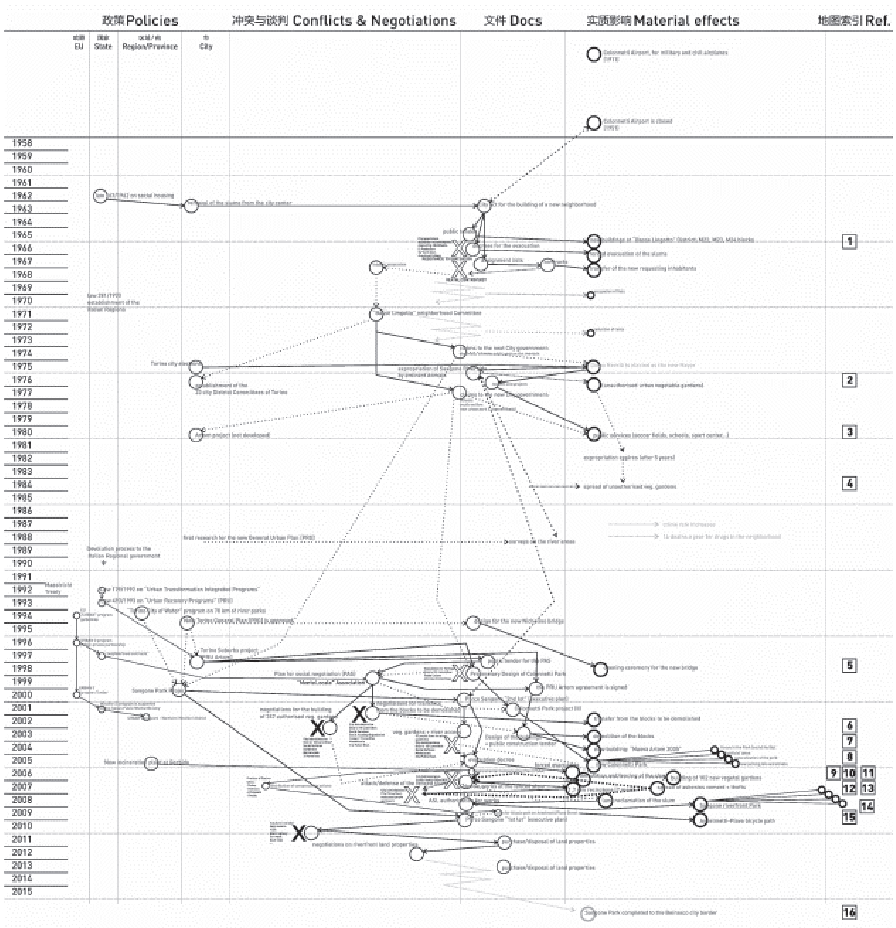
Payne (Payne 2017) developed a similar methodology, although with different categories. She did not focus only on (human and non-human) actors, but developed networks that are made of objects (actors), attributes of such objects and actions which link one object to the other.

Finally, other scholars have tried different visualizations with respect to the actors network. Bradbury (Bradbury 2016), keeping the theoretical framework of ANT, presented a representation that **takes into account the time in which the project developed**. Focusing on the energy performance of a building of which he was the architect, the author presents a diagram which shows the modification of the energy performance of a building during the time-span of the project. Each point on the diagram represents a moment in which the translation (Callon and Latour 1981) of goals of different actors, gathering around a specific matter of concern, into a common goal leaded to a change in the building energy performance. The authors therefore do not focus on the positioning of actors within the network of the whole process, but rather **connects the translations of goals of the evolving network with the duration of the process and with material effects on the building** (see Figure 3.3a).

Armando *et al* (Armando, Bonino, and Frassoldati 2015; Armando and Durbiano 2017), who worked on the architecture project within the STS framework, drawing also upon the theory of *documentalità* (Ferraris 2009), presented diagrams that share with Bradbury the focus on time and on material effects on the project. However, they also **put in light the policies that influenced the process, as well as the documents that were produced** and cumulated during the whole time-span of the transformation process. In the diagram, indeed, the development in time is shown on the vertical axis, while the horizontal one is divided into "laws and policies" which are involved in the process, "documents" and drawings presented by the proponents, "conflicts and negotiations" on those proposal, **and "material effects" on the project** (see Figure 3.3b).



(a)



(b)

Figure 3.3 - (a) Changing of the energy performance in time in (Bradbury 2016).; (b) The Shenzen diagram (Armando and Durbiano 2017). The different columns report policies, documents exchanges and material effects on the process

Finally, the combined use of different diagrams and visualizations has been suggested by projects that merged the *mapping controversies* approach with information design, developing digital tools (Ricci 2010) as well as protocols of actions and indications for researchers for the developing and testing of such tools (Venturini et al. 2015).

The work of Donato Ricci, focusing on the use of a real case study to "develop and test the capability of diagrammatic models to observe and describe controversies" (Ricci 2010) put in action the creation of different visualizations, although tightly connected with each other. The author identified three main dimensions of a complex social system: time, actors involved and interactions between them, and illustrated the construction and use of two diagrammatic tools used to manage such dimensions and allow the public to explore them. The visualizations are the result of a combination of authomatized web crawling according to pre-set parameters and researcher interaction with the tool. In this case, a timeline visualization, in which the vertical axis is used as a measurement of the actors involvement in the issue, is combined with network visualization, where the actors are categorized through colours and placed in the space according to their level of agreement or disagreement (see Figure 3.4).

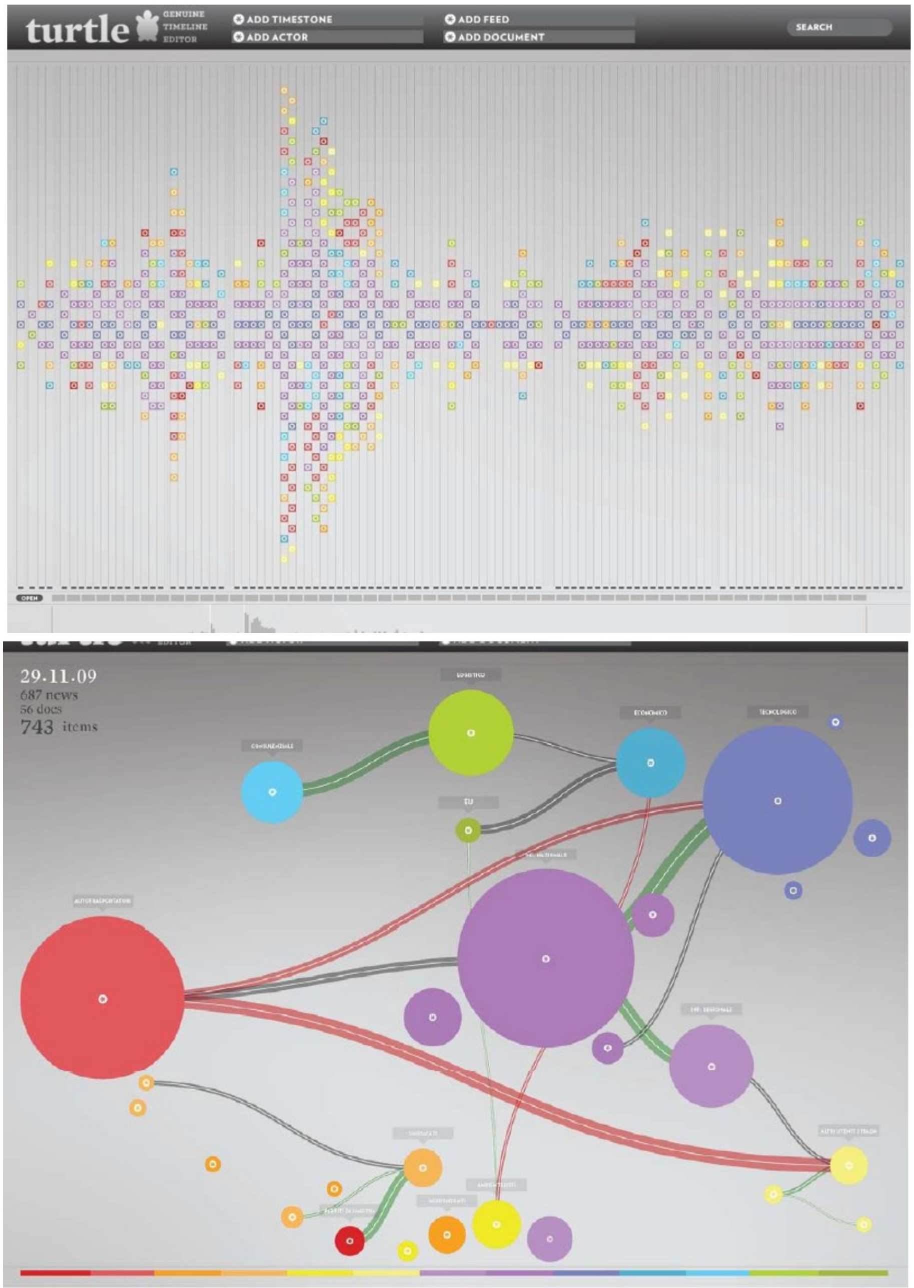


Figure 3.4 – Turtle timeline (top), that visualize the presence and activity of each actor in time on the basis of discursive fragments retrieved through web crawling results: the timeline is reported on the horizontal axis, while the vertical axis quantifies the level of activity of each actor in the debate. The different colours identify categories of actors; Turtle Dynamics(bottom), in which the network visualization is established on the basis of the connections established by the researcher between the discursive fragments visualized in Turtle Timeline.

Venturini *et al.*, in assessing the "simplicity/complexity trade-off" (Venturini et al. 2015) in which controversies maps (and mostly maps in general) are entrapped (see subsection 3.1.2, "simplify complexity respectfully") provided indications to the controversy cartographer that wants to move through this "simplicity-complexity continuum", based on their own project and experience. One of the crucial parts of such indications (together with public involvement, which will be assessed later in this thesis) is the creation of a "concatenation of different visualization tools". The authors envisioned five different visualiations, or “controversy atlases” that break the complexity of the controversy into five different layers answering to five questions,namely:

- the “tree of disagreement” that organize the debate by splitting the controversy into branches and sub-branches of topics to which the different statements of the actors are connected (“What”);
- a reconnection of each statement to their speaker, in order to reconstruct which actors share the same topic of debate (“Who”);
- the connection of actors into a network, based on their allinaces and opposition (“How”);
- situating the controversy into the “scale of dispute” to which it belongs, reconnecting it to bigger meta-controversies and smaller sub-controversies (“Where”);
- show how all the elements evolve through time, how some part of the controversies stay dormient or burts into agitated action (“When”).

While underlying that other concatenation of atlases can certainly be possible, the authors put in light the importance of finding, in any case, a way to “break down the richness of a controversy and then rebuild it through a chain of subsequent representations”.
What is also particularly interesting in the two above-mentioned studies for the aim of this thesis is the fact that they do not focus mainly on the outcomes that the diagrams allow to obtain on the particular issue explored, as it was in the studies that have been previously presented in this section, but rather on the description of the path conducted to craft specific tools and methodologies to build them, proposing a reflection on their strength and shortcomings, on the basis of a situated, direct experience, in order to provide directions for future similar researches,

3.2 Agency of visualization tools

3.2.1 Performative visualizations

As seen in Subsection 3.1.1, the quest for a new visual vocabulary is aimed at providing new knowledge and points of debate on architecture for architects-researchers themselves as well as for any kind of practitioners or users which may be involved in “the making” of architecture.

The exercise proposed by ANT scholars is not centred on designing an architecture object and trying to fit it into a slot, but on examining the impacts of a certain design and its implications. This means becoming more aware of what a design does, of its various implications within a process which is “much more complex indeed than simply trying to put a building on a site and adjust its scale, gradually solving design problems.” (Yaneva, 2012).

To use the words of Gasperoni, the shift should be from drawing as a medium of representation to diagrams with a “generative aim”. The diagram is seen as an *abstract machine*[39], a "process of construction with its own logic", a "vehicle for mental experiment and manipulation" that provides "graphic forms of abbreviation for complex schematization" (Gasperoni 2019).

Three possible uses of the diagram are defined: a presentation medium in the end phase of the design process, an operative medium in the early stages of the design and an *integrative use* in which **existing architecture is analysed through new lenses and therefore "rediscovered"**. Although Gasperoni refers mainly to spatial representation of buildings, and not to processes representation[40], an *integrative use* can be attributed also to maps describing a project process as well as the involved network of actors. This diagram is performative and "stays operative" (Gasperoni 2019), if it can be used as an experimental space, to **generate "material meaning" and even enhancing the "reorganizations of powers that the diagram as analytical and also projective tool can engender"** (Frichot 2014).

Just like maps, in the view of a part of cultural geographers, create in a certain sense a new territory by representing through selection, simplification and emphasis of specific elements, hence defining what should be kept and what should be transformed, and in what direction (Yaneva 2012), the quest for new visualization tools should enhance the innovation (Stephan 2015), by developing alternative scenarios for research and interaction (Venturini 2010), enhancing the "aids of imagination and instruments of thinking" (Latour and Yaneva 2008) that assist and amplify the design of a building[41].

Beside working as a performative tool to be used "inside the office" of the architect, the new maps should also **work to inform and reframe the debate among stakeholders** involved in a specific process, in order to better direct the process itself, as well as similar ones which may be developed in the future. The expectation is that visualizations will **enhance rationality within the debates and help to solve controversies** (Stephan 2015), allowing the designers not only to prefigure the possible implications of a project (Armando and Durbiano 2017), but to contribute in setting the path of the debates in which they are involved (Stephan 2015). In this sense, "not just changing the world, but giving others the chance to do so." (Venturini, 2010).

3.2.2 A situated, proximal evaluation

It has been so far highlighted how it is crucial, in order to talk about buildings as sociotechnical, evolving artefacts, to find new visual vocabularies that allow to

[39] In using the term *abstract machine*, Gasperoni refers to Deleuze (Deleuze 1988)

[40] Gasperoni presents, for instance, the work of Tschumi (Tschumi 1981), in which the diagram becomes a device for expanding representation possibilities, portraying new concepts of an architecture and hence exploring new possibilities (Gasperoni 2019)

[41] With this respect, see also Yaneva (Yaneva 2012) on the pedagogical aspect of the controversy mapping approach

make them visible as complex processes. Such visualisations aim to enhance new knowledge on the investigated project and to contribute in steering the debate on it. To be, therefore, performative. However, what does it mean to be performative? Or better, how can the extent to which a new visualization has succeeded in being performative be assessed?

During a meeting in which I was sharing the visualization I was developing (see following chapters) with my supervisors, a question came to the fore: "You will have to discuss your findings and assess your work at the end. How would you evaluate the maps you are presenting us?". Such question was touching what was at the time a sore point: how would I value the achievements of a work which is strongly based on visualizations, if I do not have a way to put such visualization under test?

One way of testing such media may be to compare them with outcomes of studies assessing similar issues, or to evaluate them on the basis of literature which investigates the quality of data visualization, (see for instance the work of Edward Tufte (2001)). However, despite such literature helped me crafting and refining the visualizations developed in this thesis, this kind of comparison and evaluation would still not answer to the main aim of the work, which is, in the end, not to assess the value of such visualization from an external researcher perspective, but rather to produce descriptions which could be of use for involved stakeholders, coherently with what discussed in the previous section.

A more valuable evaluation of the designed maps would therefore come from submitting it to stakeholders involved in the project, gathering their own evaluation on both the readability of such tools and the extent to which they can unveil hidden aspects of the process. In doing so, the main literature reference may be found in the concept of *critical proximity* developed by Bruno Latour (Birkbak, Petersen, and Jensen 2015; Latour, n.d.) and in the related concept of *situated knowledge* developed by Donna Haraway (Haraway 1988)[42].

Bruno Latour developed the concept of *critical proximity* (Latour, n.d.) to offer "an alternative to critical distance, especially with respect to avoiding premature references to abstract panoramas" that might "create the illusion of analytical distance, which blinds us to the task of paying close empirical attention to the issues in which we are interested". (Birkbak, Petersen, and Jensen 2015). In opposition to critical distance, the position of critical proximity is the one that allows to "induce criticality" on specific, situated issues (Latour, n.d.; Madsen and Munk 2019) granting the studied beings, fields, and objects their own rights and abilities to problematize claims (Birkbak, Petersen, and Jensen 2015).

In a similar way, for Donna Haraway the position of researchers who are external to the studied process and claim therefore to produce unbiased and objective knowledge is problematic, as this "god-trick of seeing everything from

[42] As stated by Leatherbarrow: "For a theory of performativity we should seek nothing more and nothing less: instrumental reason and the rationality on which it depends, plus situated understanding that discovers in the particulars of a place, people and purpose the unfounded conditions that actually prompt, animate and conclude a […]performances (Leatherbarrow 2005)

nowhere […] claims a position of distance that lends an unwarranted innocence to the critiques deployed by researchers (Birkbak, Petersen, and Jensen 2015). As an alternative to such kind of knowledge, Haraway proposed an objectivity which is not about transcendent knowledge, but rather about limited, located situations that allows the researcher to "become answerable for what we learn how to see" (Haraway 1988), as any research is situated and involves specific attachments to actors, interests and agendas (Jensen 2007, cited in (Birkbak, Petersen, and Jensen 2015)), and "The only way to find a larger vision is to be somewhere in particular." (Haraway 1988).

The knowledge, or the "common world" (Stengers 2005), is therefore something the researcher builds together with the involved stakeholders[43] (Birkbak, Petersen, and Jensen 2015). Latour suggests two steps for this careful construction of the common world: **crafting detailed descriptions of what derives from the investigation of researchers, and then using them to "make a common world" with stakeholders**, that includes such description, (Birkbak, Petersen, and Jensen 2015), by asking to the involved actors, as most knowledgeable critics, to manipulate and deploy them (Latour 2004).

When applied to the specific issue of evaluating a tool such as a map, a "new visual vocabulary", those indication may be translated as a first step involving the "crafting" of the tool (Venturini 2010) from close observation of real case studies and a second step involving the put in action of such tool. The second step would entail the **exposition to involved stakeholders in order to evaluate the tool effectiveness and agency in influencing their understanding of the process**. Madsen and Munk (Madsen and Munk 2019), who used critical proximity to evaluate visualization of Facebook debates in the field of school reform in Denmark, underlined how, in a pragmatist perspective, the contingent circumstances that enable actors to represent and intervene in the world is always the core issue of the research. The authors underlined how this should apply therefore also to the visualizations resulting from a specific research, by evaluating how they enhance, transform or inhibit the ability of the involved stakeholder to represent themselves. Following previous literature in STS research (Law 2009b; Munk and Abrahamsson 2012), the authors underlined how **it should be asked how the visualizations "become appropriated by actors" and "influence their imaginaries of the issue"**. In this way, a situated production and evaluation of visualization media is performed, in a cooperation that involves the researchers and the "knowledgeable" actors, which are involved in the evaluated process or

[43] According to Latour, "the world, in the singular, is precisely not what is given but what should be obtained through due process" (Birkbak, Petersen, and Jensen 2015). In ANT view, the role of the researcher is not to steer the closure of the investigated controversy, as actors and not scholars are responsible for their own controversies (Venturini 2010).

This "crafting" of the common world between actors and researchers also links to what presented on ANT by Sismondo, who underlined that ANT deals with concrete, situated actors rather than macro-level forces and that the construction of abstract theory appears as unbelievable as a miracle, unless it is systematically grounded on traced and situated interactions (Sismondo 2010) controversy[44]. What could be asked is then: “How did the users respond? And what did the tool, as a method for involving users, generate?” (see more in chapter 7), In this process **“the designed devices are put to work as part of the research methodology instead of being critiqued at a distance”** (Birkbak, Petersen, and Jensen 2015).

Venturini *et al.* further developed the issue by envisioning a “spiral of public engagement” in which visualization tools are always open to further developments that progress through cyclical processes of crafting tools and submitting it to the public (Venturini et al. 2015). By referring to pragmatist view of public (Dewey 2016), the authors underline how “there is no such thing as *the public*. Publics are always plurals and always specialized”, as “they gather temporarily around particular issues to deal with their specific consequences” and “the public of a controversy is nothing other than the assemblage of the actors involved in the debate”. Therefore, in this cyclical movement entails the design of maps for the public as much as the design of the public to which submit such maps for a proper evaluation. This will be further discussed in Chapter 7, when outcomes of the maps evaluation and possible future developments will be examined.

3.3 Summing up and defining indications for the field work

The present chapter showed how the view of architecture project promoted by ANT and STS in general requires the **shift to a new visual vocabulary that allows to understand buildings as results of complex processes evolving in time and involving different actors**. In looking for possible ways to structure such visualization tools, it started from the *mapping controversies* approach, an ANT-based teaching philosophy, deriving from the method some operative indications for working on data collection and representation.

Some examples of ANT-based visualizations of scholars conducting research relating to architecture have then been examined, showing how most of them use network representation, in order to focus on the evolving network of actors involved in the project, dividing them in categories and identifying their role in the process through the connections with other actors. Some studies set within the ANT or more generally within STS theoretical framework have however worked on different visualization schemes, making the timeline of the process development visible. In particular, Bradbury examined the process from the “mono-dimensional” aspect of the energy performance of the building, showing the different matters of concern emerging in time and connecting them to the material effects on the building energy performance (Bradbury 2016), while Armando and Durbiano focused on the role of

[44] This is what happen when controversy mapping researchers do “data sprints” with experts of the specific issue, in order to adapt their visualizations to be meaningful for the practices of the involved issue experts (Venturini et al. 2018; Madsen and Munk 2019)

norms and documents included in the project process during its evolution (Armando and Durbiano 2017).

Moreover, it has been seen how the *mapping controversies* approach has merged with information design by studies that have combined the use of different diagrams and visualizations (Ricci 2010), as well as protocols of actions and indications for researchers for the developing and testing of such tools (Venturini et al. 2015).

Finally, the last section of the chapter has focused on the issue of how **to test and evaluate the crafted visualizations**, showing how scholars in the field advocate for a **"situated" evaluation, conducted with actors involved in the process**, rather than on the use of supposedly universal and objective parameters of evaluation.

As a conclusion, the following indication can be drawn from the analysed literature on how to craft and evaluate the visualization of the selected case studies, bearing also in mind the need to answer to the questions posed at the end of chapter 2:

Data collection and representation:

Data collection and representation should be **conducted simultaneously** and inform each other;

Organization and categorization of the elements in the map should be inductively drawn from the analysed documents and refined as the research proceeds;

Different methodologies could be tested and mixed to observe the processes, and different kind of sources, deriving from the point of view of different involved actors, should be used;

The visualizations should **make the complex process legible and understandable, without oversimplifying it**.

Content of the representations:

The representation should in some way include ***matter of concerns*** **and actors** involved in them;

The **development in time** of the process, as well as the material effects on the project should be visible;

Human and non-human **actors should be organized in categories** so that it is possible to understand which kind of actors are more involved;

Within those actors, **policies** involved in the noise mitigation issue should be put in light.

Material effects of the controversies on the project should be represented.

More than one type of maps can be produced, showing complementary and connected information.

Evaluation of the visualizations:

The evaluation of the representations should be conducted through **discussions with involved actors** and **not only by the researchers themselves**.

The following chapter will focus on the steps and methods followed to craft the visualization, on the bases of the above-mentioned indications.

Figure 3.5 show a schematic **synthesis of the literature background** presented in the chapter. Key concepts are presented, together with the connections between them that allowed to construct the discourse that led to research questions and to the connection with the following chapter. For each concept, the main literature references are reported in blue.

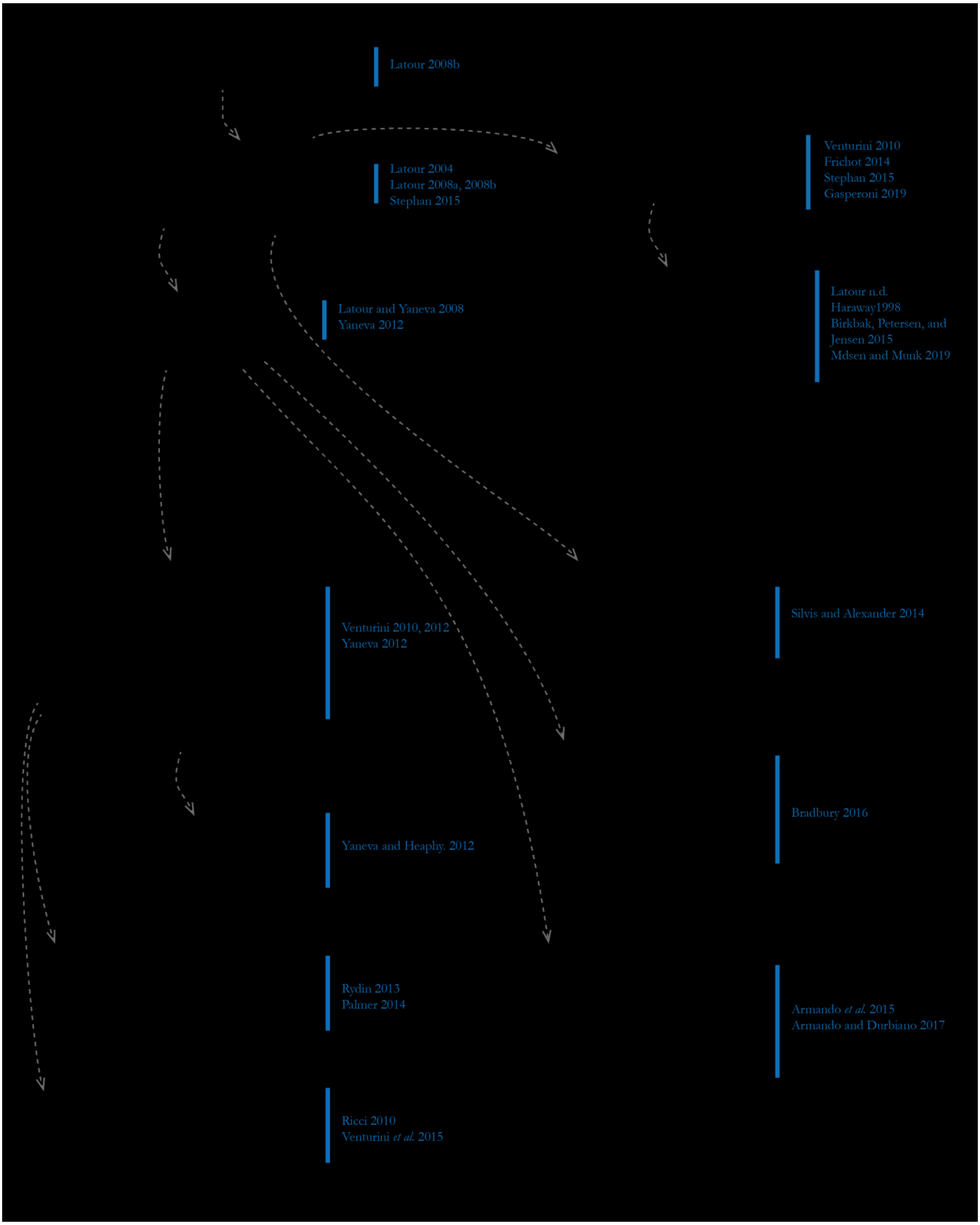


Figure 3.5 – Visual summary of the literature background presented in Cha

Chapter 4

4 Crafting maps

Overview

Chapter 4 present the methodology used to collect materials on the selected case-studies and to progressively develop a method to analyse them and visualize the outcomes into maps, focusing on the step that were made in the visualizations.

Section 4.1 introduces the field-work, explaining how the research evolved and which kind of data were used.

Section 4.2 introduces the software-assisted qualitative analysis which has been conducted on the collected materials, showing how the analysis has been structured on the basis of previous ANT-based studies.

Section 4.3 then explains how the extracted information have been reorganized into visualizations that aim to both visualize the complexity of the case studies and make it readable through designed zooms on selected parts.

Finally, Section 4.4 summarizes the steps made in the crafting of the visualizations used for the present work, together with the issues leading from one step to the other.

4.1 Introduction to the field work

As indicated in the *introduction* of this thesis, the research work started from a case-study in the city of Turin, in Italy. The case-study could be considered as a "pilot" for the city, as the approval of the zoning-plan variations that was needed to start this development process was adopted in the same period in which the local policies on environmental noise were issued (see Chapter 5 and 6). The data collection and analysis on the selected case study allowedto progressively craft and refine the visualizations that were used to narrate the process with a particular focus on noise mitigation requirements and their effects on the process, a suggested by *mapping controversies* approach (see Section 3.1).

Following a methodology that is often used in ANT-based studies (Fountain 1999; Latour 1996; Rydin 2013)[45], the main part of data was obtained through the collection of "verbatim accounts of real-life interviews along with genuine documents"(Latour 1996), and the "close reading" of the collected materials (Rydin 2013).

[45] As reported by Fountain: "ANT can be applied to many formats: interviews, newspapers, magazine and journal articles, documentaries, television and radio broadcasts, Infonet, etc" (Fountain 1999)

Data collection was started from the "voices" of the actors (See Section 3.1), conducting open interviews with the involved stakeholders. The information collected through the interviews were then expanded through the documents that were provided by private practitioners and that could be retrieved from the local environment office archive, as well as from the building permissions archive of the city of Turin. Further interviews served then to confirm the understanding of the documents and to deepen specific aspects. The number of interviews was also expanded through the use of short consultations with focused questions, which were identified as the analysis of the collected materials went on. Moreover, in-field observations were conducted on discussions which took place on the building site, that allowed some aspects of the negotiation to arise.

The study was expanded by conducting a part of research in the Netherlands, which have been selected as a foreign case study as they are regarded by the city of Turin as a case of "best practice", in which the policies for outdoor noise mitigation are in force since the early Eighties (see Chapter 8). Interviews conducted with local civil servants, architects, developers and acoustic consultants allowed, through some detours, to identify one case-study in the city of Utrecht. Here noise policies and their interpretation through local guidelines had a significant role in shaping the building design and which contributed then to a questioning of such guidelines by the civil servants themselves.

Also in this case, data collection included verbatim reports of interviews with involved stakeholders, as well as documents from the local Environment Area, the Building Permission archive and the private archive of the acoustic consultants involved in the process. Since the process was already closed before the research took place, a direct participation through in-field observation of the process was not possible, however the other kind of collected sources were similar and the process used to collect and analyse materials was the same as the one adopted in the Turin case-study. This aspect will be further discussed in the *conclusions* section of this thesis, in which strength and drawbacks of the methodology are examined.

The rest of this chapter explains the development of an attempt to draw maps of the process that are accurate and "grounded" on the collected data, but at the same time can make the complexity of the process readable (Venturini 2010) through the use of software-assisted analysis and drawings. Following the example of previous works that have provided accounts on the path followed to design mapping tools and processes starting from specific controversies (Ricci 2010; Venturini et al. 2015), the chapter presents the different tools that were tried in this process, together with the issues encountered, in the hope that such effort may serve to inform future works struggling with the hard task of finding new "visual vocabularies" (see Subsection 3.1.1).

4.2 The "crafting" of descriptive tools 1 – stay grounded on words, organize them

4.2.1 Noticing, Collecting and Thinking

In accordance to what suggested by the *mapping controversies* approach (see Section 3.1), in the analysis and representation of the studied processes, the aim was to stay close to the words of the actors, listening to them "more than to my own presumption" (Venturini 2010). Therefore, maps and description of the process had to stem from a close-reading of the documents, to be "grounded" on the words found there. Some automated method for word extraction, such as text mining and network text analysis, were initially explored, but this generated complex visualization on which little control was allowed (Figure 4.1). Moreover, the focus of the study was not the structure of the analysed interviews and document, but rather the story they were telling, in order to find then a suitable way to render it. A turn to qualitative analysis methodologies was therefore set.

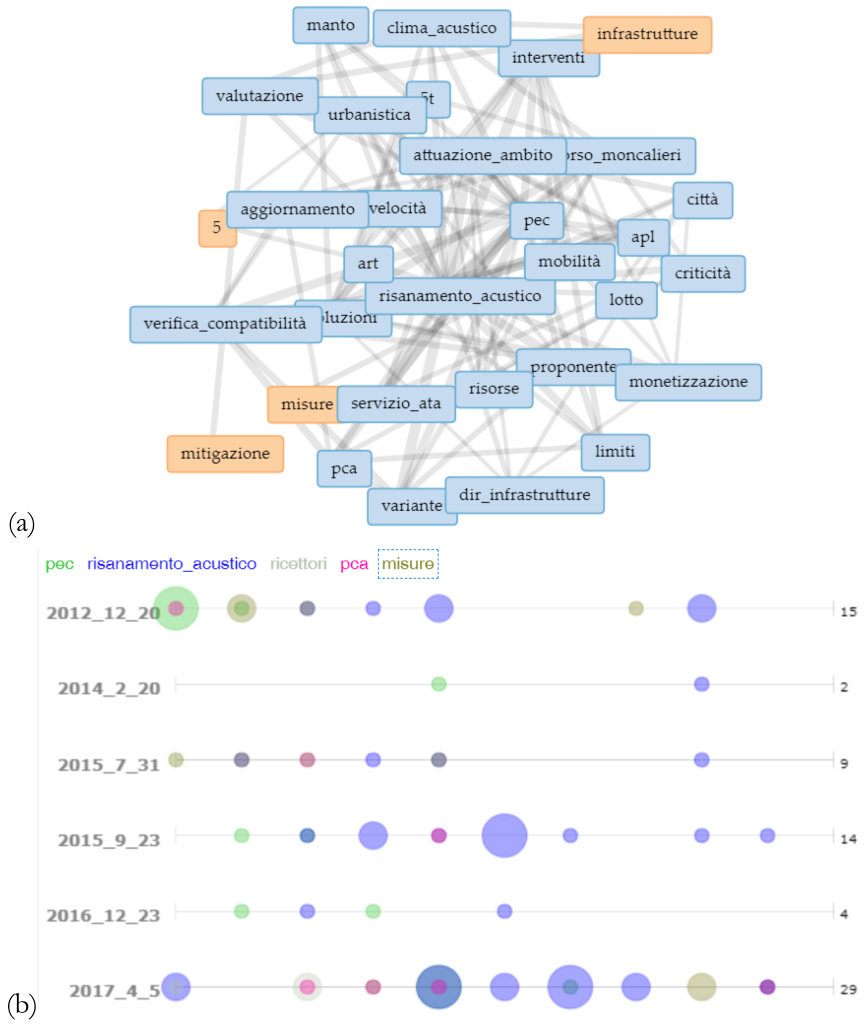


Figure 4.1 - -(a) Semanthic network and (b) bubble lines representing the occurrence of different terms resulting from an exploratory analysis conducted through Voyant tools on a sample of the documents regarding the Turin case-study, presented in Chapter 6

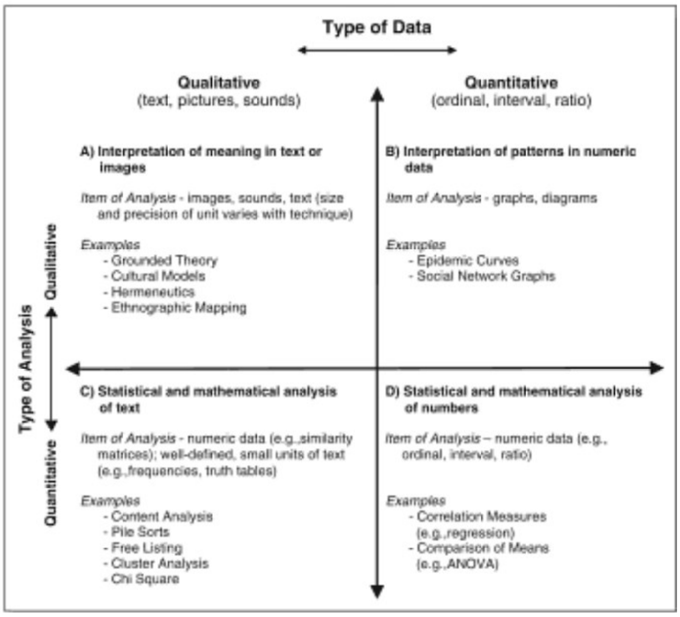
Without going too deep into a distinction between different type of analysis, which is out of the scope of this work, it is useful to say that the analysis **sets within the qualitative analysis of qualitative data** (Bernard 1996) (Figure 4.2a). Within this particular frame, it sets on the side of exploratory, "content driven" analysis, in which themes and key topics are inductively extracted from the data and classified through a system of codes[46] which is gradually constructed by the researcher, as the data collection and analysis evolves (Figure 4.2b).

The study does not aim to set very strictly within one specific qualitative analysis methodology, in all its very codified passages, but rather to grasp from those methodologies what can be useful to support the construction of an ANT-oriented analysis and description of the studied processes. This "method assemblage" (Law 2004) is, after all, in line with ANT perspective, as ANT is composed by a varied family of tools and methods of analysis (Law 2009a). Also, ANT- derived approach of controversies mapping does not require a specific methodological protocol, inviting researchers to use every available tool provided by pre-established methodologies, as well as mixing them (Venturini 2010)[47].

The qualitative methodologies which have mainly informed this work can be found in Grounded Theory and Qualitative Content Analysis methodologies. Indeed, what ANT-based observations share with Grounded Theory (Charmaz 2006; Glaser and Strauss 1967; Heath and Cowley 2004) is the flexibility and creative approach to inquiry (Cho and Lee 2014), the start of inquiry with a research question that identifies the topic of investigation without making too many assumptions on it and the iterative refinement of data collection and analysis, including a wide assortment of data collection techniques (Willig 2013). However, unlike Grounded Theory, the interest here is not in "generating a substantive theory"(Cho and Lee 2014), which would also be, in some sense, contradictory with an ANT-based approach, that is "descriptive rather than foundational in explanatory terms […] It tells stories about "how" relations assemble or don't"(Law 2009a).

[46] Seidel explain coding as follows: "Coding data is a simple process that everyone already knows how to do. For example, when you read a book, underline or highlight passages, and make margin notes you are "coding" that book. Coding in QDA [= Qualitative Data Analysis] is essentially the same thing. For now, this analogy is a good place to start"(Seidel 1998)

[47] As said by dr. Steve Wright, training and consultancy expert for Atlas.ti, in an email conversation on Atlas use in ANT-based research: "At the end of the day with ANT there is no "RIGHT" way of doing it – which is why it should appeal, if you wanted a recipe do grounded theory. The key thing will be to justify and explain your decisions and how they stay true to the words and meanings of the actants." (23 October 2018)



(a)

Exploratory ("content-driven")	Confirmatory ("hypothesis-driven")
• For example, asks: "What do x people think about y?"	• For example, hypothesizes: "x people think z about y"
• Specific codes/analytic categories NOT predetermined	• Specific codes/analytic categories predetermined
• Codes derived from the data	• Codes generated from hypotheses
• Data usually generated	• Typically uses existing data
• Most often uses purposive sampling	• Generally employs random sampling
• More common approach	• Less common approach

(b)

Figure 4.2 - – (a) Classification of different type of analysis, according to Bernard (Bernard 1996), as reported in (Guest, MacQueen, and Namey 2012); (b) distinction between exploratory and confirmatory qualitative analysis (Guest, MacQueen, and Namey 2012)

With this respect, therefore, the approach is more close to Qualitative Content Analysis, since it focuses on "extracting categories from the data" (Cho and Lee 2014), i.e. on finding keywords and themes which can help to structure the analysis of the collected material, with a view to the maps that could be used to visualize the process in the present study.

What the analysis work shares with the above-mentioned methodologies is the "Noticing, Collecting and Thinking" method (Seidel 1998), which is nothing but a way to name an "interactive and progressive", "recursive" approach, in which the more documents are analysed, the more the codes system is widened, modified and reorganized, in a "painstaking process of coding and re-coding"(Guest, MacQueen, and Namey 2012). This is, after all, another way of describing what it is suggested for the mapping controversies approach (see Section 3.1).

In order to work on the collected data with such method, a CAQDAS (computer-aided qualitative data analysis software) was used. In this case, there's no automatic extraction and the process is analogous to a manual analysis.

However, the software has a number of benefits regarding the features of documents navigation, connection between parts of documents and navigation between a very close reading of the single document and an overview of the whole system of extracted codes. This highly facilitated the task of organizing codes into categories and in general of structuring the process description. Moreover, visualizations of the outcomes could be obtained through the software, as will be further explained in the following Subsection.

4.2.2 The software Atlas.ti

The software used for the analysis of the collected material is Atlas.ti, originally developed at TU Berlin, from researchers working with Grounded theory methodology (Legewie 2014), allowing for "flexible mode of operating, […] through the interplay of the researchers' brains and skills with the data" (Friese 2016),

As specified in the latest version of the software manual (Friese 2019) *"Although ATLAS.ti facilitates many of the activities involved in qualitative data analysis and interpretation (particularly selecting, indexing/coding, and annotating), its purpose is not to automate these processes. Automatic interpretation of text cannot succeed in grasping the complexity, lack of explicitness, or "contextuality" of everyday or scientific knowledge*"

These excerpts are useful to understand the basic characteristics of the software that are central in its use for this research:

- The possibility to work on different kind of data and to organize them through **groups of documents**, hence making it easy for the researcher to navigate through documents and link different sources discussing the same topic;
- The possibility to assign **codes** to selected parts of documents [=**quotations]**, **link** and organize codes and quotations, taking notes through memos and comment on every step of the work, hence facilitating the "noticing, collecting and thinking" methodology.
- The non-automation of the process: it is up to the researcher to choose what to code, which code to assign to each quotation, and how to organize codes in different categories.

The "analysis" part of the software allows then to **query the coded data**, searching for codes occurrences across the documents and co-occurrence of different codes, hence helping the search of specific actors through the process, or finding quotations linked to one or more codes (Friese 2019)allowing to reconstruct the debate around a specific topic.

The structure of connected elements (codes, quotations, documents, etc.) can be displaied in **networks** that help to visualize and conceptualize the underlying structure of the work. This feature was at the basis of the first visualizations of the process, as will be further explored in this chapter. Figure 4.3 shows a screenshot of Atlas.ti user interface.

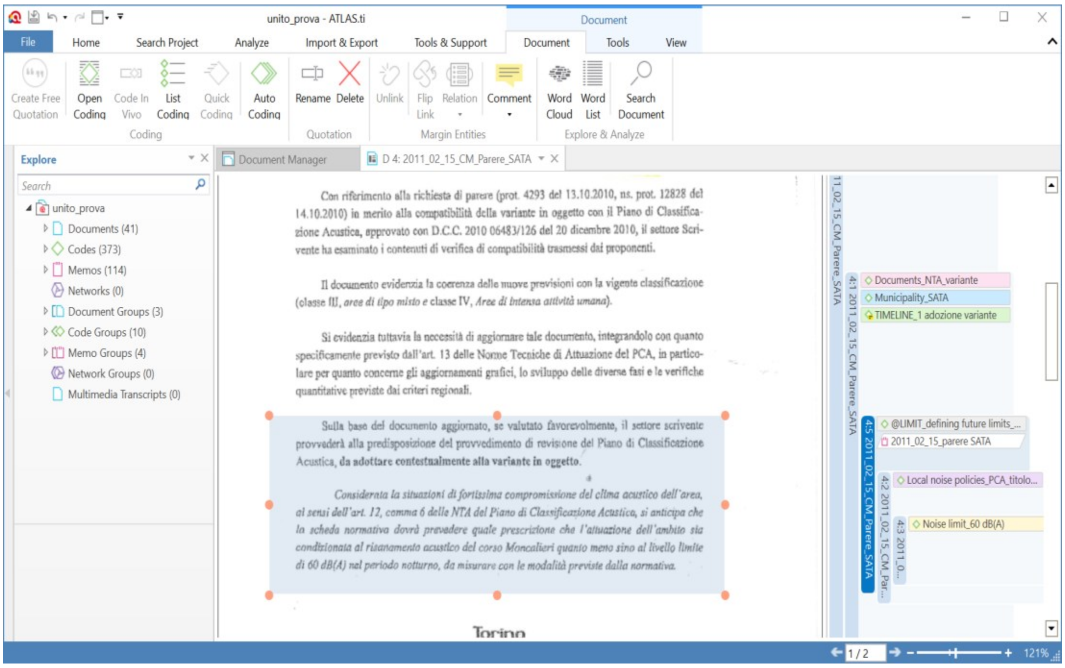


Figure 4.3 - Atlas.ti user interface. The navigator on the left allows to browse through the system of documents, codes, memos, etc. In the central part there is the analysed document, with quotations marked in blue. On the right, quotations are associated to codes assigned by the user

Although, as said before, the basis of the software were informed by Grounded Theory methodology, the freedom in use of all the elements of the software make it suitable also for ANT-based researches, as shown by Wright (Wright 2016). The author, although recognizing that the ANT-based “method assemblage” (Law 2004) may challenge many of the conventions on the use of qualitative analysis software, at the same time pointed out how Atlas.ti can be used for ANT-based researches. Indeed it allows to manage heterogeneous sources, to extract codes from them and connect such codes to explore sequences and assemblages of actors and actions. This allows also to gather information in a chronological order, while organizing them into evolving categories (Latour, 2005, cited in (Wright 2016), through the creation and grouping of different codes.

4.2.3 What to look for in the data?

As said, CAQDAS kind of software do not substitute at all the researcher in defining and constructing the system of codes and themes that are extracted from the analysed documents. As efficaciously reported by Wright “There are no fixed frames or recipes in these waters, and the terms and ideas that swim in them are as slippery as salmon” (Wright 2016).

Hence, the definition of some rules for the extractions of codes was necessary, as they would guide the development of the work in consecutive steps, preventing from getting lost in the cascade of codes and concepts emerging during the work, while at the same time avoiding to pose too much constrains to the inductive emerging of codes from the documents analysis. Themes had to emerge from the voice of the actors, but it was necessary to pose them the right questions.

On the basis of the guidelines defined at the end of Chapter 3 (see Section 3.3), the analysis was therefore structured in few broad but clear levels, developed through progressive refinements, like a PDCA cycle (plan, do, check, act) (Figure 4.4).

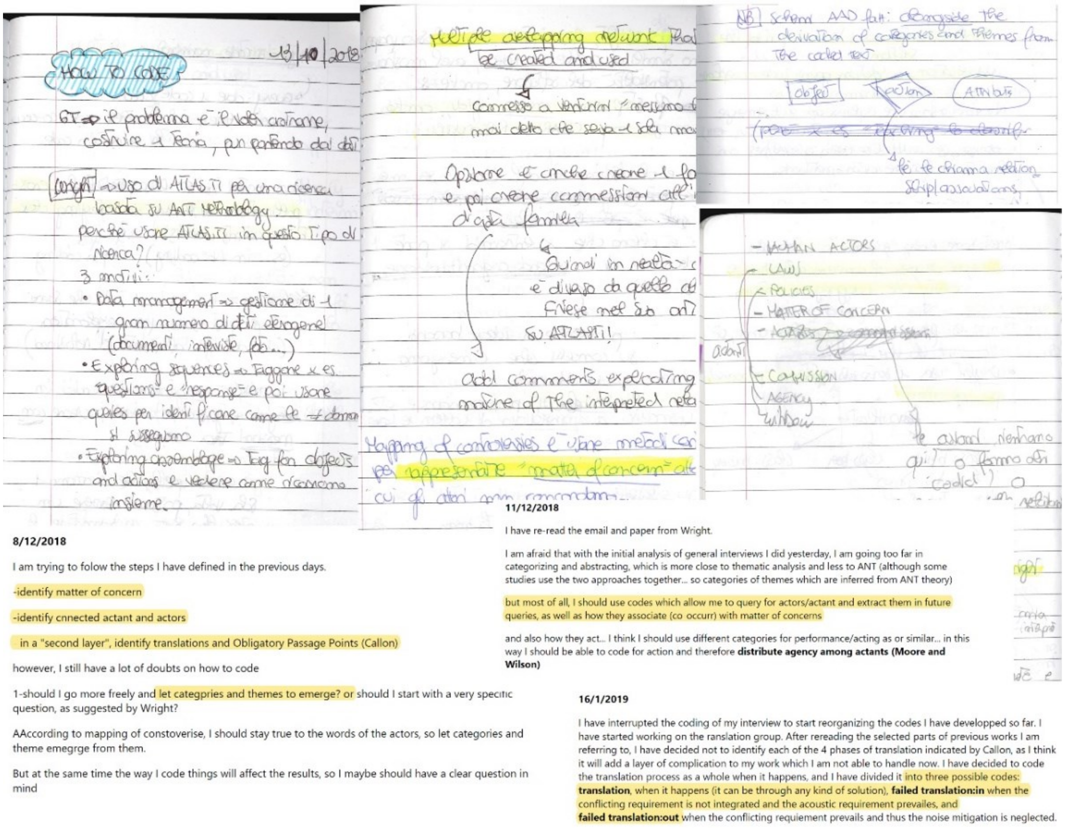


Figure 4.4 - Excerpts from the code-developing process. Hand notes from literature and parts of the "how to code" memo developed in Atlas.ti, in which I noted how I was developing the coding system

Three different **steps of analysis** were finally defined, namely:

- **Step 1:** the process as a series of *matters of concern* that develop in time:

In this step, the corpus of documents referring to a case-study is analysed looking for **problems which were debated during the process** (Bradbury 2016). Quotations that discuss the same concern were "tagged" (Friese 2016) with the same code. Through network visualization is then possible to visualize how a debate evolved around a certain concern, as shown in Figure 4.5.

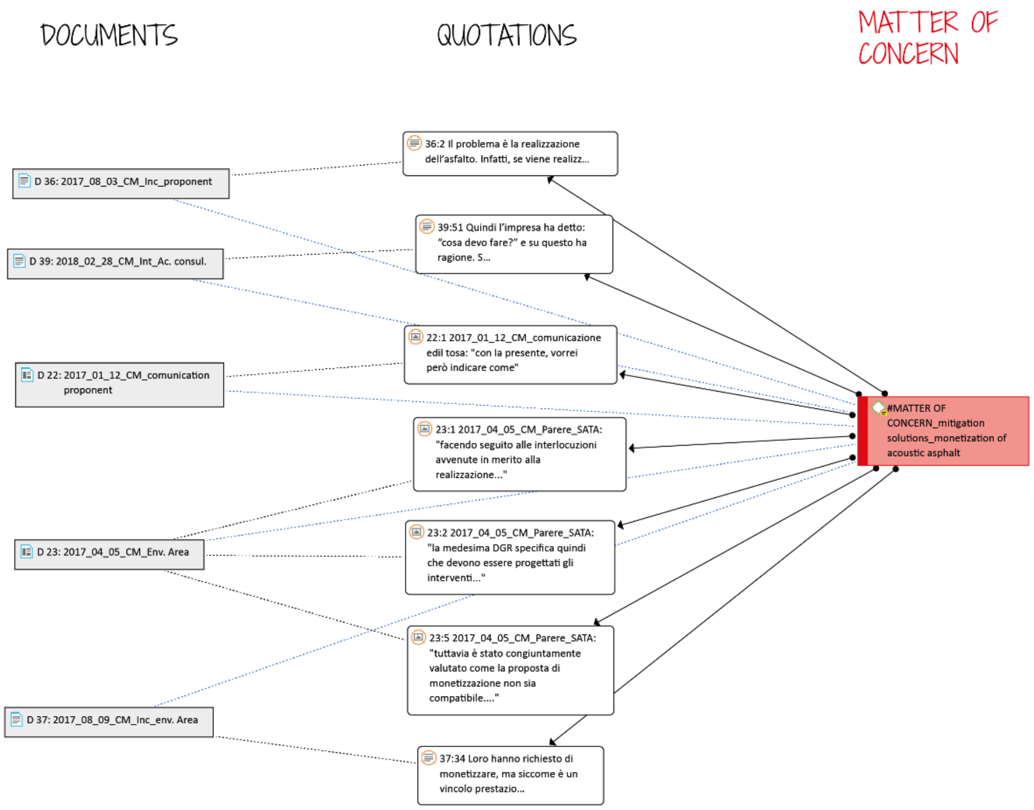


Figure 4.5 – Visualization of the debate around the concern "monetization of the acoustic asphalt", showing the sources in which such matter of concern was found and the quotations discussing it

- **Step 2:** the matter of concern as a series of actions which are done to move toward an "closure mechanism", i.e. to try to reach the end of a *matter of concern* (Pinch and Bijker 1989):

After having identified the concern, actors that gathered around it were searched, by coding for any kind of actor (human actors, laws, proposed mitigation solutions, and so on) that was named in the documents when a certain concern was being discussed. "Clouds" of actors where then starting to grow around the identified concerns. As previously mentioned, the analysis of documents allowed to progressively and inductively define and refine the categories of actors

However, as those clouds of actors were growing, they resulted to be insufficient to describe the process and to really understand how actors where moving around specific issues. Therefore, **actions performed in the definition of specific *matters of concern* were searched in the documents and then connected to the actors involved in them**. Again, in these case moving from close, single-document reading to general overview of the extracted excerpts and vice versa helped to identify types of actions that were performed in order to solve the different concerns. The categories of actions were inductively derived from data analysis, although the concept of *translation* defined by Callon and Latour (see Subsection 2.1.3) was helpful in the definition and ordering of such categories. Table 1 shows the categories of actions which have been identified, together with the correspondence to ANT-based concepts of *translation*.

Table 4-1 – Categories of actions an corresponding examples

Link with the "translation" concept	Category of action	Example
Fact building	Request support/clarification/data	Request for a monitoring campaign
	Provide/check data	Measurements in test environment
Defining obligatory passage points	Set a limit/binding request	Definition of new limit of 60 dB(A) at side road
	Restate limit/request	Reaffirmation of previous noise limit
Moving towards a translation	Propose a design/make a suggestion/proposal	Proposal of modification in sleeping rooms position in plans
	Partially integrate request/proposal	Integration of air conditioning system
Failed translation	Discussing/opposing/not integrating requests	Presentation of the limits to the use of sound absorbing cladding
Translation	Accepting a request/opposition	Acceptance of the maintenance of existing bank guarantees

- **Step 3:** the action as a gathering of different human and non-human actors

In the third step, each excerpt corresponding to an action was analysed again in order to **extract the human and non-human actors which were involved in the actions** (e.g. laws or policies which allowed for the refusal of a certain solution, data that supported the decision, etc.). The documents were explored while asking: what is happening here? Who/what is really acting and influencing the process? This also helped to purge the analysis from elements that may be just named but did not have an agency in the process.

Moreover, while the coding process was evolving, the codes referring to different actors were organized into categories, inductively derived from an analysis of the code system.

Figure 4.6 shows a map obtained through Atlas.ti analysis. The same *matter of concern* shown in Figure 4.5 is expanded first through the actions that are done to discuss it and then, for each action, through the actors acting in it. The category assigned to each actor is indicated by the colour of the labels, as explained by the legend in the figure. This could be considered as a visual displaying of the "redistribution of agency" (Moore and Wilson 2014) advocated by ANT scholars (see Chapter 2). Indeed, the action is not limited to the blue labels (human actors) who fix the new limit, but it can be seen how it entangles also many other categories of actors, such as the national and local noise policies, as well as other not noise-related policies and characteristics of the specific context.

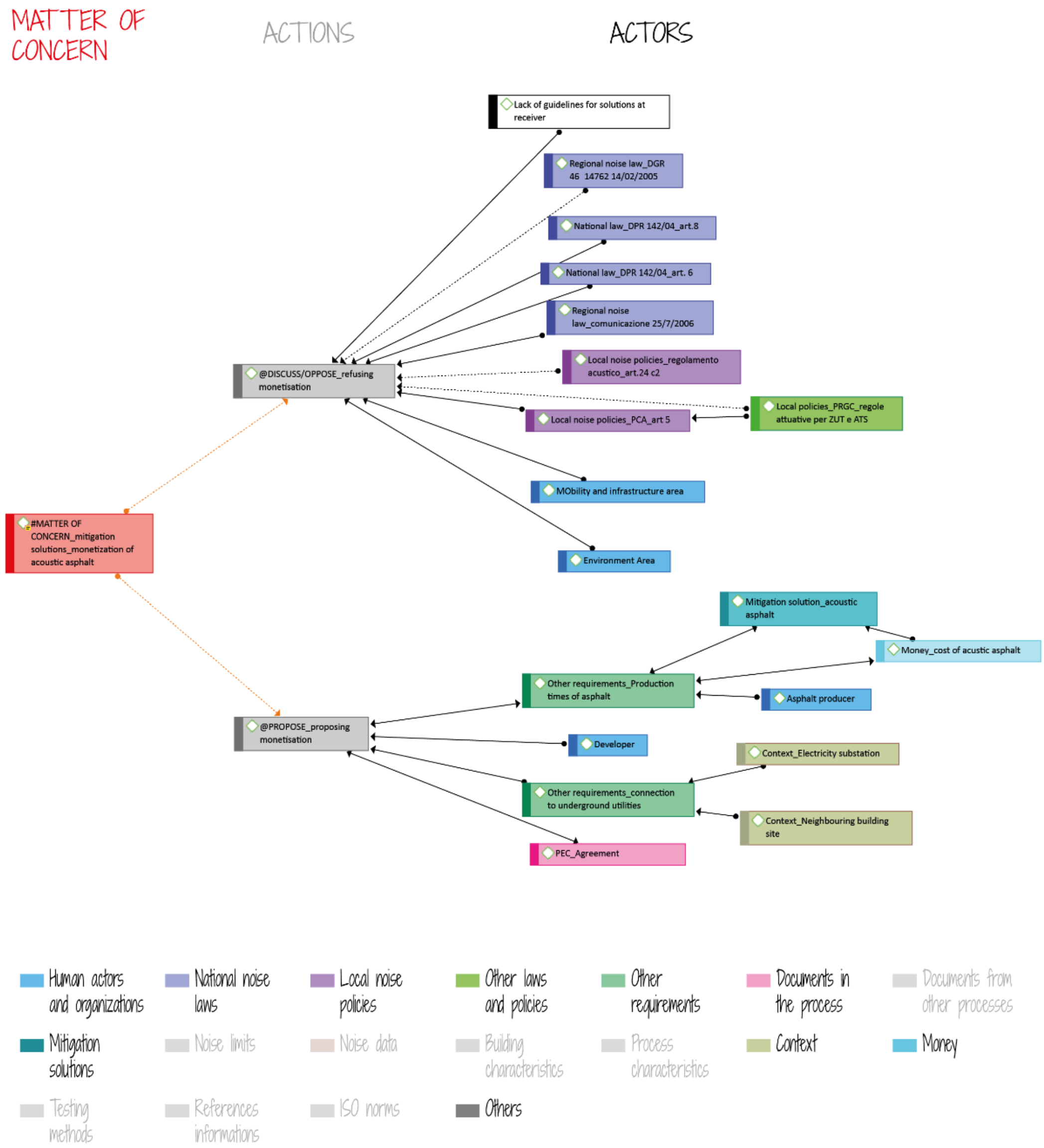


Figure 4.6 – The network of actors resulting from Atlas.ti coding of actors involved in the matter of concern "monetization of the acoustic asphalt"

4.3 The "crafting" of descriptive tools 2 – visualize the process, focus on specific questions

As shown in the previous section, CAQDAS software allow to extract network visualizations on the basis of the defined system of codes, selecting information which belong to a specific set of documents, exploring links starting from a selected code, as seen in Figure 4.5 and 4.6, or showing the whole system of codes in a complex network. Supported by previous ANT-based studies which have focused on the network concept and visualization (Palmer 2014; Yaneva and Heaphy 2012) also through the help of social-network analysis software (Rydin 2013), the initial aim of the research, with respect to visualization outputs, was to take advantage of the features of the software, as well as of its interoperability with other social-network analysis software, in order to obtain network visualizations based on the qualitative analysis described in the previous section.

Figure 4.7 and 4.8 report two examples of those first attempts of network visualizations. Figure 4.7 shows a visualization obtained through the network visualization tool of a qualitative-analysis software on a small part of the documents concerning the case study in Turin[48]. In the map, the different entities identified in the analysis, i.e. *matters of concern*, actions and actors involved are located into different coloured stripes (red, grey and orange stripe respectively), as well as connected with the bureaucratic phases of the process in which they emerged (green stripe at the top of the image) and the documents in which they emerged (pink stripe at the bottom of the image). Links between codes are defined on the basis of the code co-occurrences.

Although just some of the "action" nodes (black points in the grey stripe) are "exploded" to show all the actors which are entangled in it (coloured points in the orange stripe), it can already be witnessed the complexity of the network that is resulting from the analysis.

Figure 4.8 show a map obtained through the Excel plug-in NodeXL (Smith 2014) for the first phase of the same case-study process, i.e. the zoning plan approval. In this case, a code co-occurrence table is exported from Atlas.ti and imported in NodeXL. The plugin allows to "collapse" all the nodes that belong to the same category into one single node, hence allowing for a simplified visualization in which it can be seen the importance and centrality of each category of actors. Each node represent a category of actors, while the thickness of each edge between two nodes represent the co-occurrences of actors belonging to the two categories.

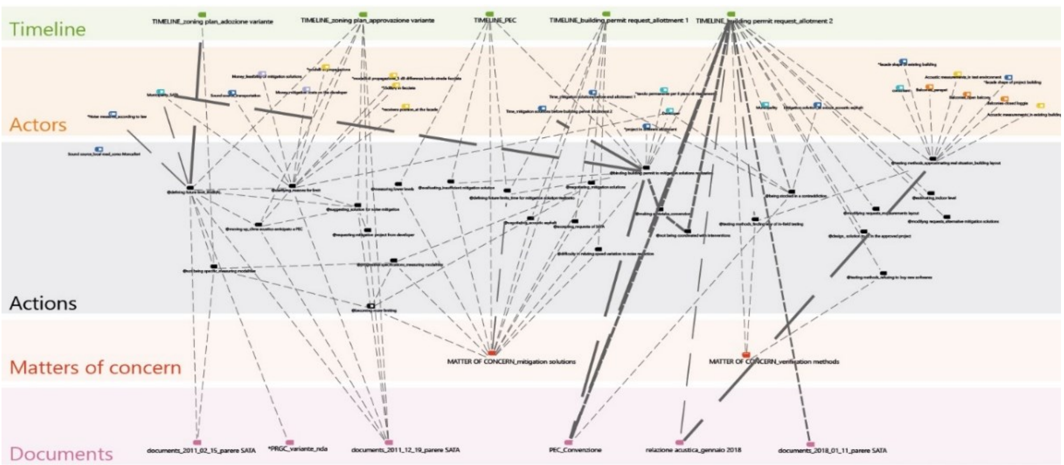


Figure 4.7 – Visualization resulting from qualitative analysis of some of the documents involving the process of "ZUT 13.11 Moncalieri" case study.

48 In this case, the visualization is obtained through MaxQDA software, which is a CAQDAS software which shares most of the features of Atlas.ti, and work with the same coding methodology explained in this chapter. Both software were tested at the beginning of the coding phase, and, while MaxQDA has a visualization tool which may fit better the scope of this work, Atlas.ti was chosed in the end as it allows to link memos to codes and to set links between quotations, hence helping a better structuring of the analysis.

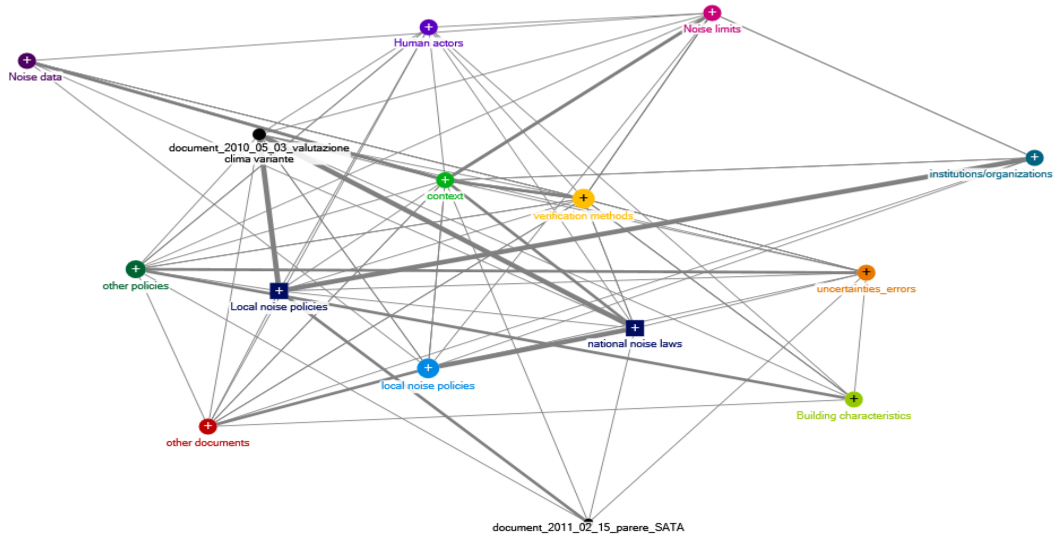


Figure 4.8 – Node XL elaboration of the network of actors involved in the first phase of the project (adoption of the zoning plan). The Fruchterman Reingold algorithm is used.

However, the software-based network visualizations posed some issues in the attempt to reach the goals of the visualizations crafting, as defined in Section 3.3. The first issue is that time is not visible in the network. Moreover, in this case the drawing of links between one actor and the other remains debatable: how to establish the strength of a link? Its definition from a personal understanding of the network resulted to be extremely uncertain, and in this case also co-occurrence of terms is a simple but week rule. However, the establishment of links between actors is, in the end, all what networks visualization are based on and this could heavily bias the process description. Finally, such networks resulted to be too "omnicomprensive" to describe the process in a way that could be strategic to answer to specific questions and inform future processes (Armando and Durbiano 2017). Although they may be useful to have a general look at the process as a whole, they do not allow to focus on the process development in time and to split information on different layers. Therefore, **a network visualization could be useful for an in-deep exploration of a given moment in the process, showing the network that stabilized in order to make possible a specific step in the process. However, it needed to be integrated with other kind of visualizations**, which could show the development in time of the process and its effects on the project, as defined in Section 3.3. The need to design different "controversy atlases" to explore different aspects of the process (Venturini et al. 2015) was being experienced first-hand.

It was therefore decided to go back to hand drawings, taking advantage of the freedom it gives in the spatial organization of elements and in the use of graphical language, and trying to "craft" my own mapping devices (Venturini 2012), using the analysis developed in Atlas.ti as a support in navigating through documents and codes in order to select the information to be put on paper, as the software "enables a range of tools and methods to be used to help follow that actor/actant with freedom of movement across a diverse set of heterogeneous data"

4.3.1 The general framework of the maps

The first step of the crafting of new maps was to define a basic framework which could allow to have an overview of the whole process, without overcrowding the map with details that could then be explored in further steps. **The basic framework develops in time on the horizontal axis[49], while the vertical axis has different levels,** in which information derived from the above-mentioned 3 steps of analysis are organized. Figure 4.9 shows a scheme of the general framework map. The map is organized as follows (see corresponding letters in Figure 4.9):

a. **the human actors and organizations and the documents through which they acted**: reports, official evaluations, but also informal communications or in-person meetings of which there are recalls in documents or interviews. This level visualizes the growing "documental collective" (Armando and Durbiano 2017) which constitute the project, with respect to the specific issue of noise mitigation, allowing to identify which other actors, beside the proponents and the environment office, are involved in the process and at which phase;
b. **the policies and laws involved in the process**. This level reports specific categories of non-human actors which are involved in the process with respect to noise mitigation issues, namely the noise-related and non-noise related policies and laws.
c. **the concerns that developed during the process**. Differently from what is done by Bradbury (Bradbury 2016), in which the matter of concern are single point in a timeline, in this case they are represented as bars which span the timeline going from the first document in which they were identified to the one in which they are closed with a decision/agreement, showing where controversies are active or when they stay latent ;
d. **the effects on the process**. The effects are divided between the acceptance or refusal of the project from the acoustic point of view ("red" and "green" lights) and the material effects on the project, hence the modification in the design due to noise mitigation issues, visualized through dashed lines at the bottom of the map, derived from the socio-technical diagram presented in the Subsection 2.1.2 (see also Subsection 4.3.2);
e. **the bureaucratic phases of the project** (from zoning plan approval to building permit granting), defined by thick vertical lines scanning the process timeline.

[49]It is of support for our visualizations what stated by Edward Tufte in its seminal book on data visualization (Tufte 2001), although originally said with respect to time-series for quantitative data: "With one dimension marching along to the regular rhythm of seconds, minutes, hours, days, weeks, months, years, centuries, or millennia, the natural ordering of the time scale gives this design a strength and efficiency of interpretation found in no other graphic arrangement."

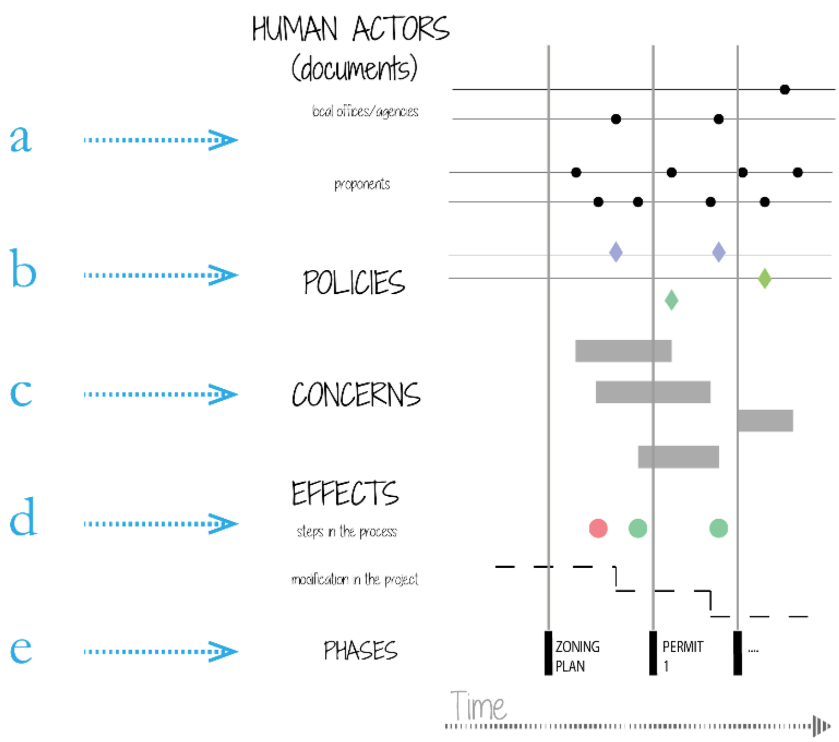


Figure 4.9– General framework of the maps with the three levels on the vertical axes

Similar to what realized in above-mentioned studies (see Section 3.1), the exploration of how elements evolved through time is therefore implied. Differently from other studies (Ricci 2010; Bradbury 2016), the position of the elements on the vertical axis does not correspond to a specific quantitative parameter, but rather orders different levels through which it was decided to read the process, on the basis of research questions and previous literature (see Chapter 2 and 3), in order to put in light the "controversy dynamics" (Venturini et al. 2015).

Drawing a comparison with the structure of the "Shenzhen diagram" presented in Subsection 3.1.3 (Armando, Bonino, and Frassoldati 2015; Armando and Durbiano 2017), it can be seen how the diagram has been used as a reference in the definition of the maps crafted in the present work. In particular, the development in time and the division in policies, exchange of documents between involved stakeholders and effects on the process has been maintained, although arranged in a different layout. The "concerns" section has been added between the document exchange and its material effects in the process. Such section "expands" the negotiation by defining the topics which are debated, i.e. "step 1" of the analysis presented in Subsection 4.2.3.
Figure 4.10 shows a comparison between the scheme of the Shenzhen diagram (left side of the figure) and the scheme of the maps realized in this research (right side of the figure), with indications of the different levels in the two schemes, in order to allow for a comparison.

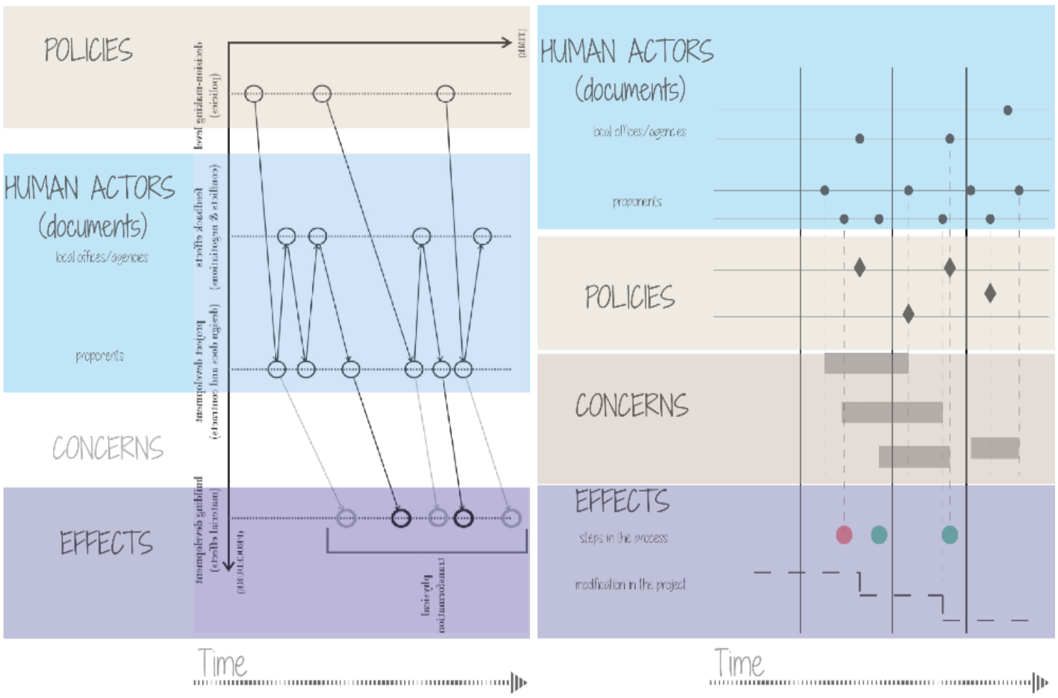


Figure 4.10– Comparison between the scheme of the Shenzhen diagram retrieved from Armando and Durbiano (Armando and Durbiano 2017)(left) and the scheme of the maps used in this research, presented in Figure 4.9(right), with indication of the different levels of the schemes. The Shenzhen diagram has been rotated with respect to the original layout (see Figure 3.3 b), in order to facilitate the comparison

Figure 4.11 shows the general framework map applied to the first case-study in Turin. The map will be explored and commented in Chapter 6. However, it is now useful to have a view of the results of the map applied to a real case-study.

As can be seen, 5 different bureaucratic phases are passed in the process in the time-span considered in this work and 10 different human actors and organizations were involved in the process (names in the “human actors” section). Noise mitigation policies (violet rhombuses in the “policies” section) were involved through all the process, while other laws and requirements (light green and dark green rhombuses in the “policies” section) were involved in the later phases of the process. 8 *matters of concern* emerged during the process (grey bars in the “concerns” section), which can be grouped in 4 topics (black names in the “concerns” section): mitigation measures at source, realization modalities of such measures, limits and verification modalities and mitigation measures at receiver. Moreover, 3 modifications to the building design and 4 modification to the road design were produced during the process, in relation to noise mitigation issues (“steps” in the dashed lines in the “effects” section).

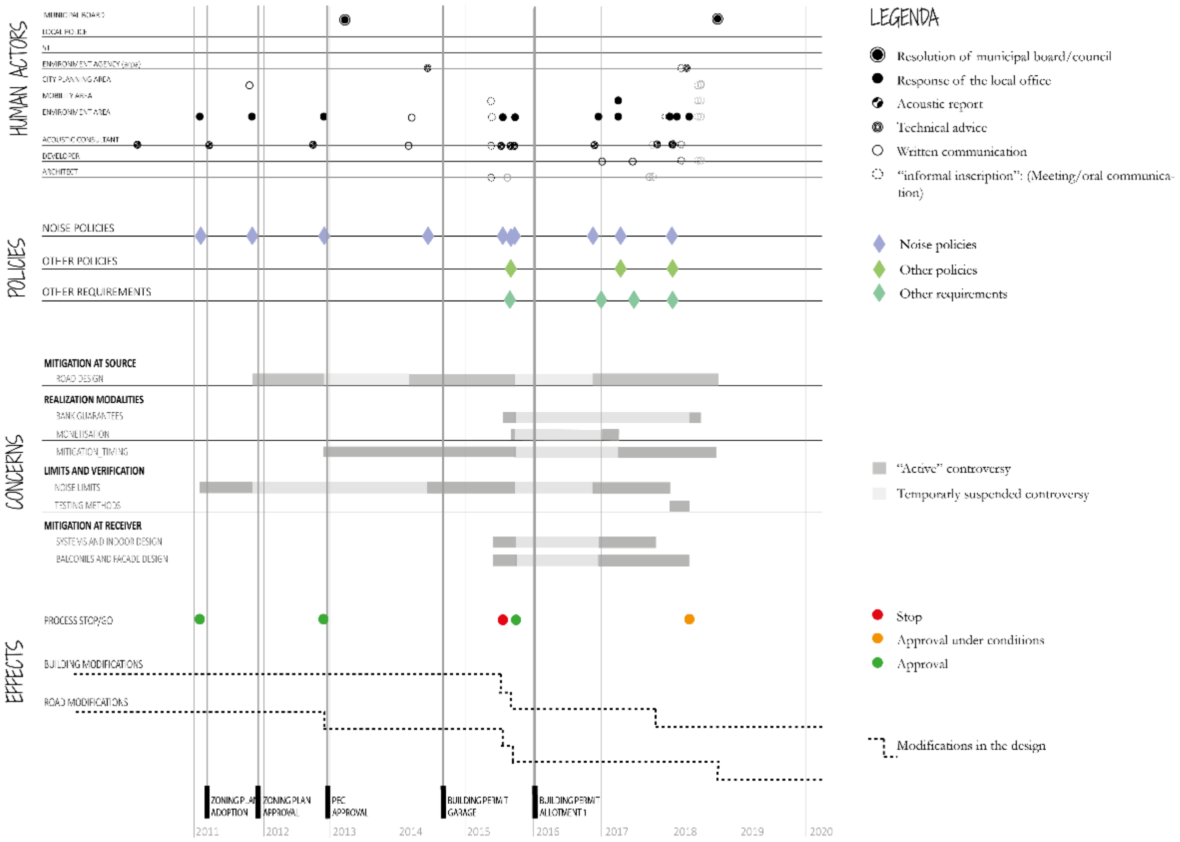


Figure 4.11 – example of the general framework map for the Turin case study

4.3.2 Exploring entanglements to answer specific questions

The following steps of the analysis can then be seen as progressive detail explorations on selected parts of the map, guided by the research questions defined in Section 2.4, with the aim, as previously said, to read the process both in its development in time as well as with respect to specific concerns and networks of actors.

Three type of detail explorations where then identified, two of which explore the development in time of a specific aspect of the process (namely, a specific **concern** or the presence of specific type of **actors** in the process, expecially focusing on policies), while the third one uses the network visualization to explore the entanglements involved in a **specific document or moment** of the process.

1. **Concerns:** one of the *matters of concern* is selected and examined with respect to which actions are done and why. Which are the actors involved in the specific concern? What actors contribute to the successful or failed *translation* of certain solutions? Which are at the end the material effects on the project?
   Figure 4.12 shows a scheme of the “concern” map. **The “concern” map is organized in the following levels** (see corresponding letters in Figure 4.12):
   a. Starting from the general framework map, the selected **matter of concern** is firstly expanded **with the actions** taken to reach a translation;

b. below the grey bar of the examined *matter of concern,* is reported a **list of the solutions examined during the process**. For each solution, it is indicated when it has been proposed, accepted or contrasted (black arrow, green tick or red X on the line corresponding to each proposed solution);
c. the table on the right part of the map shows, for each mitigation solution, on the corresponding line, the **non-human actors** which influenced its proposal, acceptance or refusal. Each column corresponds to a category of actors derived from the analysis of documents and interviews, so that for each solutions it can be seen which actors were involved;
d. finally, in the lower part of the map are reported **the material effects on the project**. Each successful translations, defined by the integration of a certain solution (represented by a green mark on the line) determines a modification in the project. The project modifications are represented through the use of the "sociotechnical diagram" (Latour 2013), which was introduced in Subsection 2.1.2, (Armando and Durbiano 2017). Here the associations are of course the progressive integration of noise mitigation requirements, while the substitutions represent the new project which is defined at every association (even with very slight modification with respect to the previous one). In this way, it is possible to immediately see how the specific concern has physically transformed the building.

Figure 4.13 shows a legend of the symbols indicating the different actions (a) as well as a representation of the "material effects" part through the use of the sociotechnical diagram, in order to clarify the reading of the map presented in Figure 4.14.

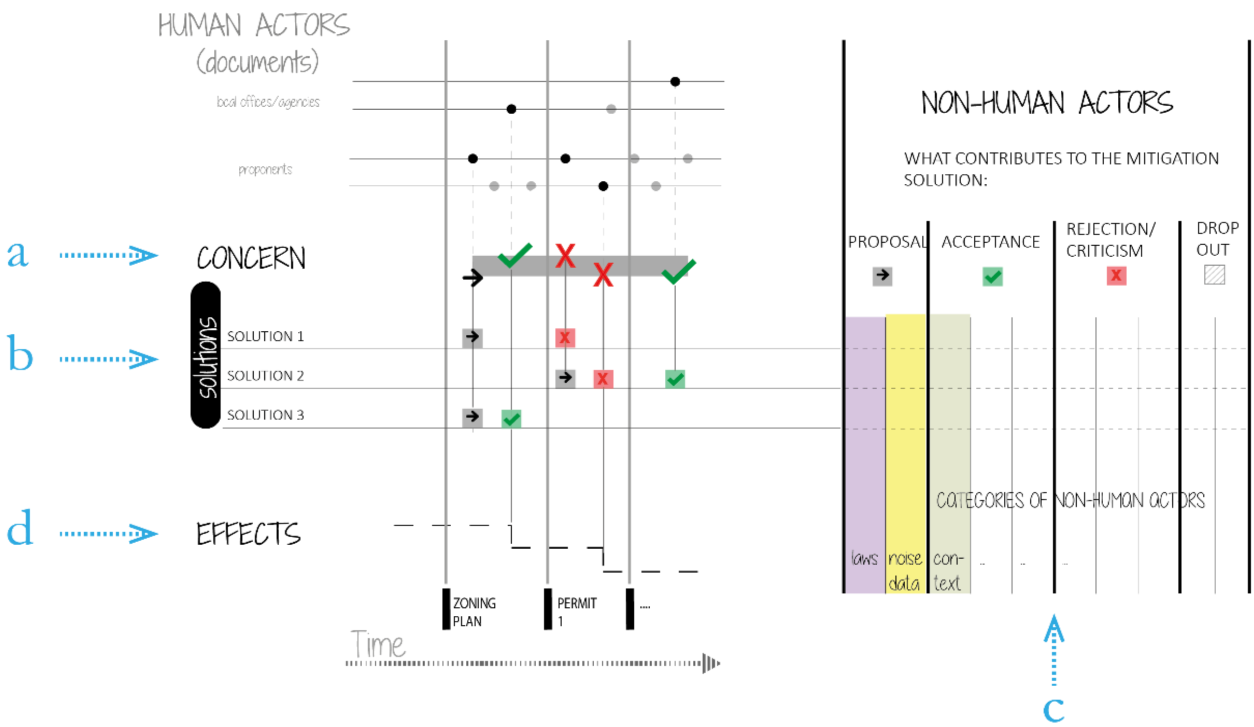


Figure 4.12 - Scheme of the "concern" map

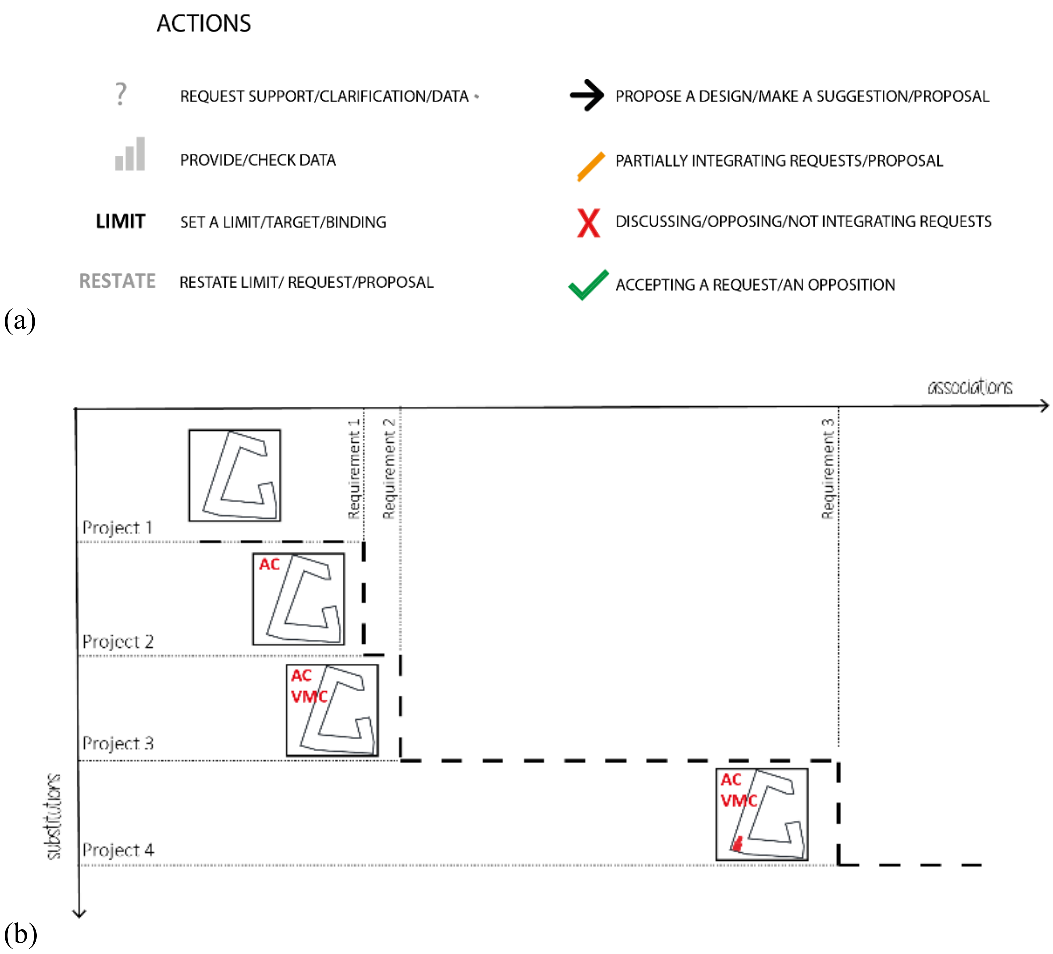


Figure 4.13– (a) Legend of the different actions used to describe the evolution of the debates around each matter of concern; (b) The material effects on the project seen as a "sociotechnical diagram" in which progressive integration of noise mitigation solutions are displayed

Figure 4.14 presents an example applied on one of the concerns raised in the process of the Turin case-study. In particular, the map focuses on the *matter of concern* related to possible mitigation solutions to be realized at source. As can be seen in the map, only the documents involved in the specific *matter of concern* are marked in black, while the other documents are in grey. Every document involved in the concern is connected to the action in which it was involved by a dashed vertical line. Below he grey bar of the *matter of concern,* 6 different mitigation solutions are listed, i.e. all the mitigation solutions at source that have been considered through the process. Every time a proposal (black arrow), rejection (red cross), partial acceptance (yellow slash) or total acceptance (green tick) of some solutions is done in the process (see action symbols along the grey bar of the *matter of concern*), the action is further explored to put in light which mitigation solution at source has been proposed, accepted or rejected in that specific moment. For example, by looking at the first three solutions listed, we can see that "traffic light synchro" (first solution listed) was proposed at the very beginning of the negotiation, but it was then ignored until the last phase of the process examined (after the granting of the first building permit), when it was then openly rejected for two times. On the other, the portal with messages to enhance speed reduction (Chapter 6 will better explain the various mitigation solutions) was proposed right before the approval of the executive planning instrument (*PEC*). After being explicitly rejected for two times, it was then re-proposed in the final stages of the negotiation and finally accepted (due to the modification of some conditions, as will be shown in Chapter 6). Finally, the lit pedestrian crossing was proposed before the *PEC* approval and accepted right after the proposal.

On the right side of the map, the non-human actors that contributed to the proposal, acceptance or rejection of each solution are listed, divided in columns that correspond to the various categories of actors defined during the analysis of the collected material. Without going too much into the details, it can be seen that, for instance, all the three mitigation solutions mentioned above were proposed for reasons linked to the specific context in which the project is located (greenish column in the table) and the portal was accepted because of specific characteristics of the process (brown column) while the pedestrian passage was accepted because of noise data on the estimated noise reduction provided by it (yellow column).

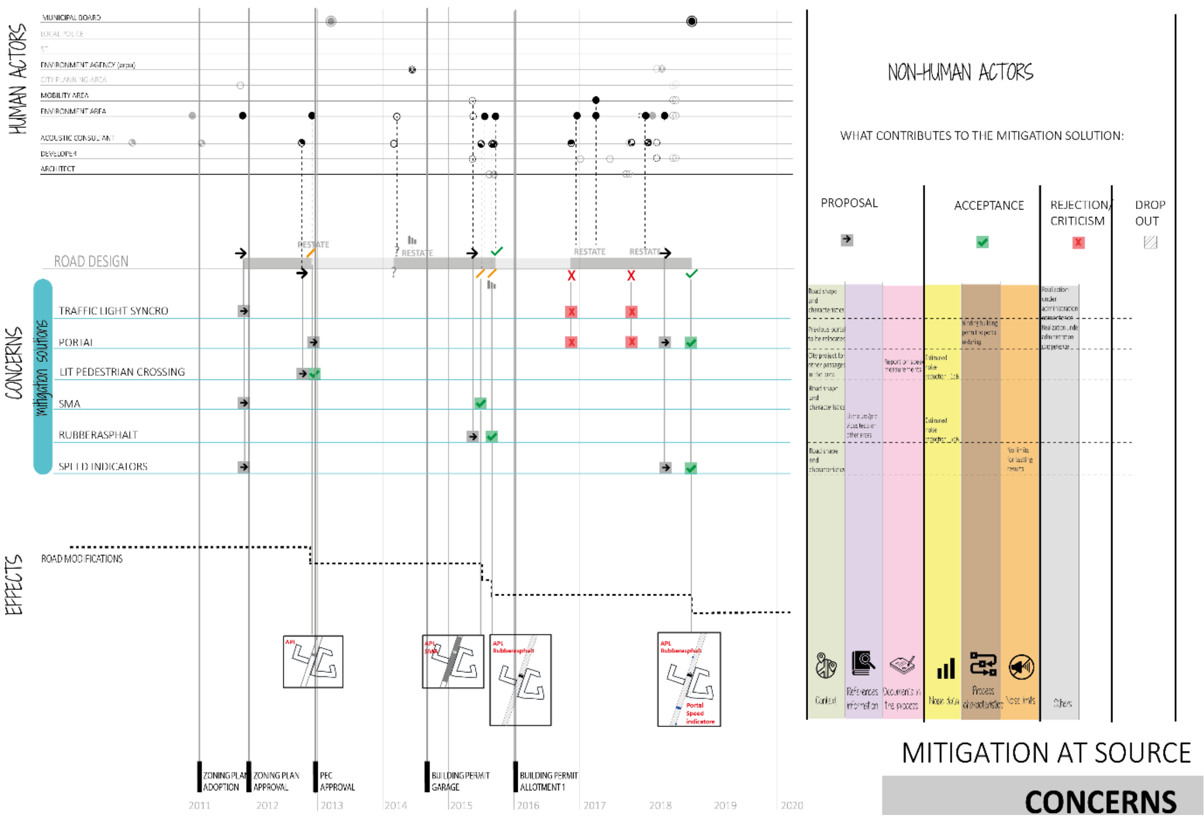


Figure 4.14 – "concerns" map developed for the Turin case-study

2. **Following specific actors:** the whole map is navigated following a specific categories of actors over time. Given the research questions defined in Section 2.4, this type of maps has been particularly used to focus on the role of policies (see Chapter 6).

Figure 4.15 shows a scheme of the map used to follow the role of specific actors in the process. In this case, the map focus on national laws and local policies regarding noise mitigation and put in light in which phases of different matter of concern they acted. **The map is organized in the following levels** (see corresponding letters in Figure 4.15):

a. starting from the general framework map, the **"policies" section** is expanded in order to present the list of laws and policies that were involved in the process. The laws are divided on national, regional and local level. Each line represent a specific law;
b. and a sign (a rhombus) is put on the line in correspondence **to the moment of the process in which a certain law or policy had a role** in the process.
c. the rhombus is connected to the **document that referred to the law, as well as to the specific action**, discussing one of the *matters of concern*, in which it was involved.

In this way, it is possible to immediately see which part of the policies directly influenced the project. This information might be useful especially for local policy-makers.

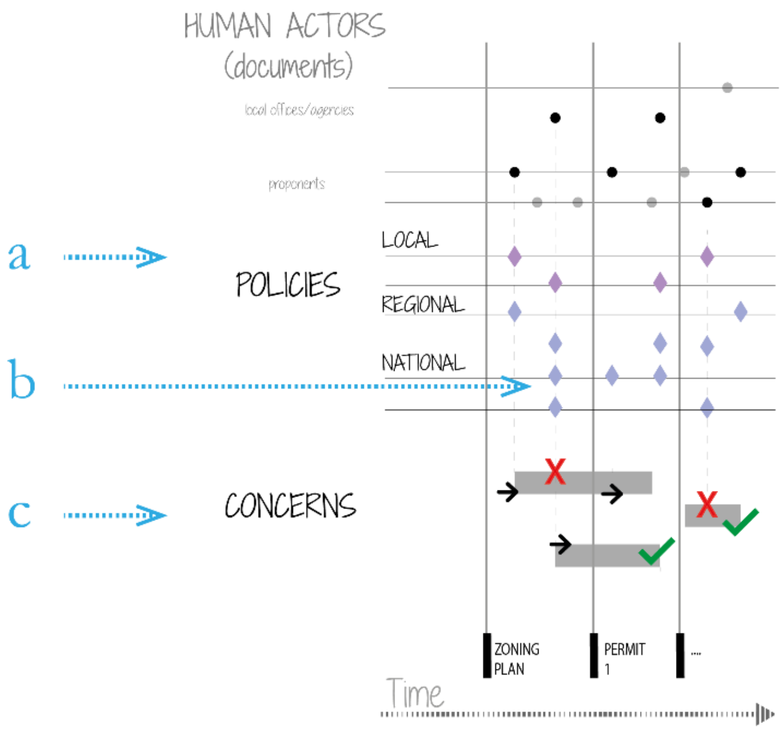


Figure 4.15–Scheme of the "policies" map

Figure 4.16 shows the map applied to the case-study. In particular, the map focuses on noise mitigation laws and policies in the process.
Also in this case, only the documents that involved noise mitigation laws and policies are marked in black, while the other documents are in grey. Every document is connected to the action in which it was involved by a dashed vertical line.

In this map, the “policies” section is expanded in order to show the complete list of all the national, regional and local policies, related to noise mitigation issues, that were involved in the process. Every line in the “policies” section correspond to a law. A violet (for national and regional laws) or purple (for local policies) rhombus is placed on the line corresponding to a specific law or policy every time it is involved in an action.

In this case, for instance, it can be seen that both local and national policies were involved through all the process, although, especially in the case of national laws, only two implementing decrees were involved. Laws and policies were involved only in 4 of the 8 *matters of concern* emerged in the process, namely monetization of mitigation solutions, timing of their realization, limits to be respected and verification modalities (the topic will be fully addressed in Chapter 6).

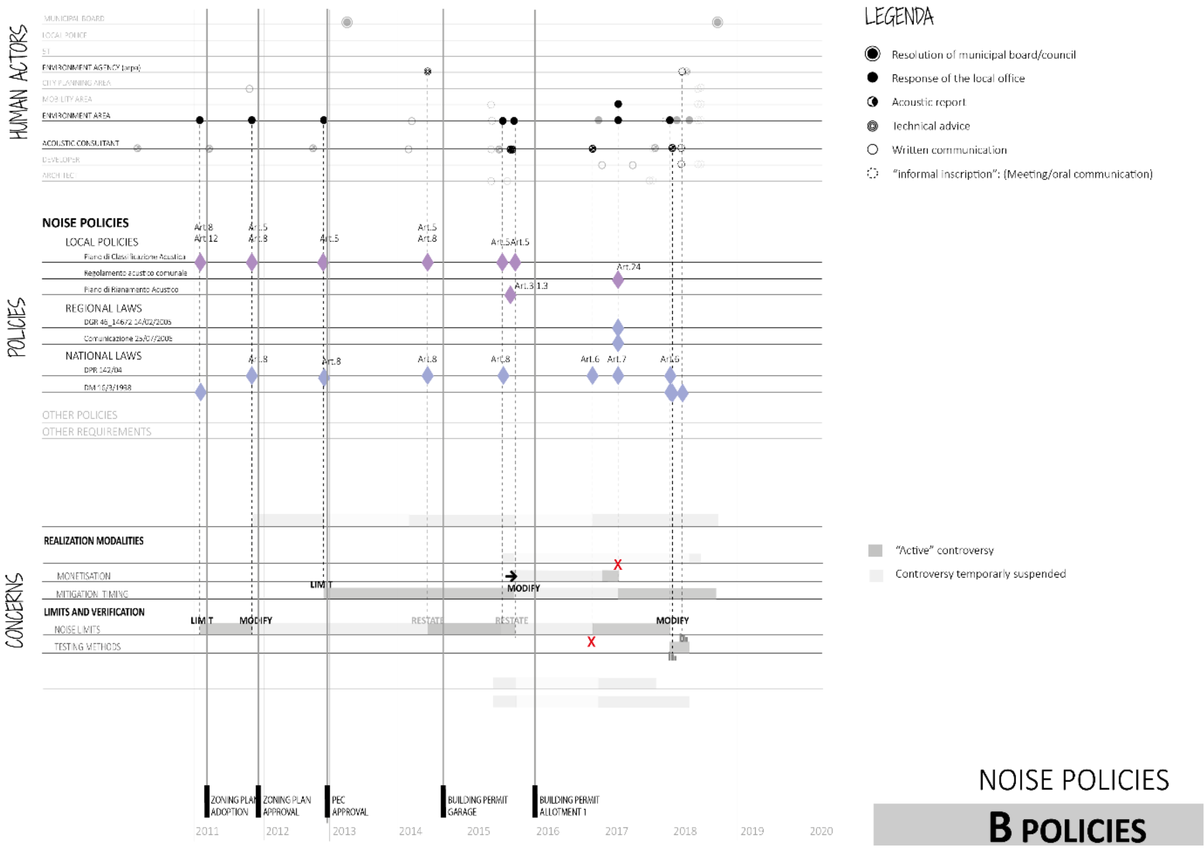


Figure 4.16 - –“following policies” map developed for the Turin case study

3. **Networks entangled in specific actions/documents:** in this case, the visualization of the development in time is not used, as the focus is on a specific moment of the process. Hence, a network visualization (see Section 3.1) is considered more suitable to explore how a certain network of actors temporarily stabilized (Latour 2005b) in order to allow for a certain decision or the production of a certain document in the process. Therefore, the network visualization are used as a completion to a series of different visualizations (Ricci 2010; Venturini et al. 2015). . Such networks do not consider the reciprocal position of the actors in the whole controversy (Ricci 2010; Palmer 2014; Rydin 2013) but are rather used to further expand specific moments of the process (Silvis and Alexander 2014).

Figure 4.17 shows an example applied on the moment in which the first building permit was granted to the Turin case-study. The grey label on the right defines the action, while all the other labels are the network of actors that temporarily stabilized in order to make that action possible. As can be seen by the legend in the image, different colours of the labels indicate different categories of actors involved in the action. In this case, the acceptance of the proposed mitigation solutions for the granting of the building permit for allotment 1 of the project is due not only to the decision of the Environmental area (blue label), but also to specific characteristic of the process (brown label), to local noise policy (purple label) that allow such decision, to previous documents produced in the process (pink labels) and to the noise reduction expected for the proposed solutions (yellow labels) that, in turn, are linked to the specific mitigation solutions (dark green labels), to previous documents produced in the process (pink labels) and to data derived from previous case studies and other sources of information (lilac labels).

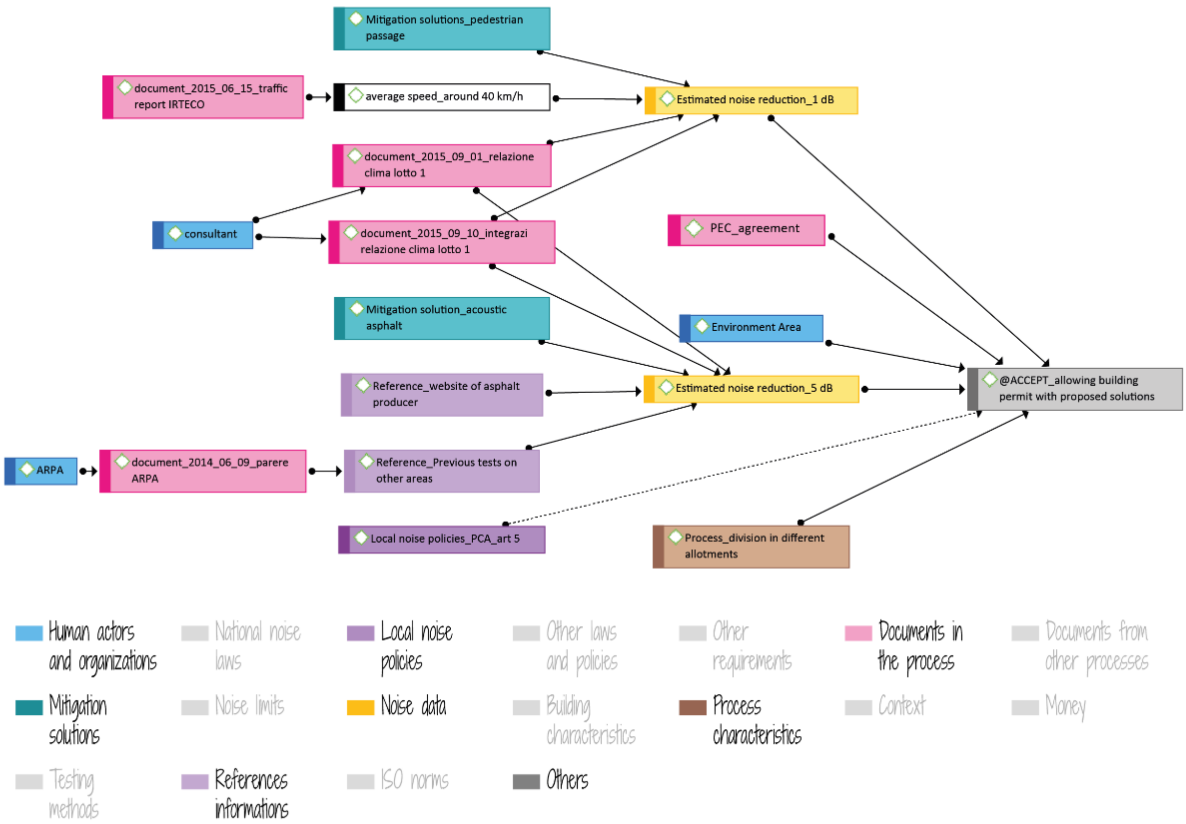


Figure 4.17– Example of a network map developed for the Turin case study

4.4 Summing up: the path to “craft” maps

In this chapter it is presented the process which was undertaken in order to craft maps that could be useful to answer to research questions defined in Chapter 2, following the guidelines defined in Chapter 3.

The crafting of visualization tools went through the **definition of a family of methodologies** from which an ANT-based research could find operative indication, to the **identification of proper software** that could support the analysis of documents and the **definition of levels of information to be extrac**ted from the analysis, on the basis of ANT and STS-based previous researches, as identified in Chapter 3.

In particular, the use of qualitative analysis through the support of CAQDAS software Atlas.ti was used. The three levels identified for the analysis were:

- ***matters of concern*** emerged during the process (Latour 2004, 2008b);
- **actions** made in order to reach a solution to the matter of concern;
- **human and non-human actors** (Latour 1987; Yaneva and Heaphy 2012; Latour 2013) involved in each action.

The network visualization obtained through software-assisted analysis was however considered insufficient to structure the visualization in order to properly explore the process and answer to the research questions. **The crafting of visualization was then continued through hand- crafted maps and schemes, to be integrated with network visualization** for in-deep investigation of specific moments of the process.

A general framework map, showing the development of the process in time, was then designed. The map presents the document exchange between human actors and organizations involved in the process, together with the different *matters of concern* that emerged in the process and the material effects on the project.

Moreover, two different typologies of detail investigation maps were designed. The first one focuses on the different *matter of concern*, exploring the actions taken to search for a solution of the controversy, the solutions that are considered during the process and the actors involved in the proposal, refusal or acceptance of each solution.

The second one follows specific categories of actors, in particular in this case policies, through the whole process, putting in light the actions and *matters of concern* in which they are involved.

Moreover, network visualization obtained through CAQDAS software were used to visualize specific networks of (human and non-human) actors in selected moments of the process.

Figure 4.18 summarizes **the different steps of the process**, indicating the issues that leaded from one step to the other, in the hope that such efforts could be of some use for scholars engaging in similar works in the future.

In this aspect, the work places itself between studies that applied existing tools to explore and visualie a process or a controversy (Rydin 2013; Palmer 2014) and studies that from the beginning focused on designing new visual vocabularies and tools that could be used to explore a specific process or controversy (Silvis and Alexander 2014; Armando, Bonino, and Frassoldati 2015; Ricci 2010), as it first explores the use of existing technological tools to support data analysis and visualization on the basis of predefined concepts, and then tries to define new visual tools to integrate the shortages posed by such tools.

As shown in the image, the last step in the development of the maps presented in this chapter are the results of focus-groups presented in Chapter 7.

In the following parts of the thesis, it will be shown how those maps have been applied on real case-studies and the outcomes which have been derived from it.

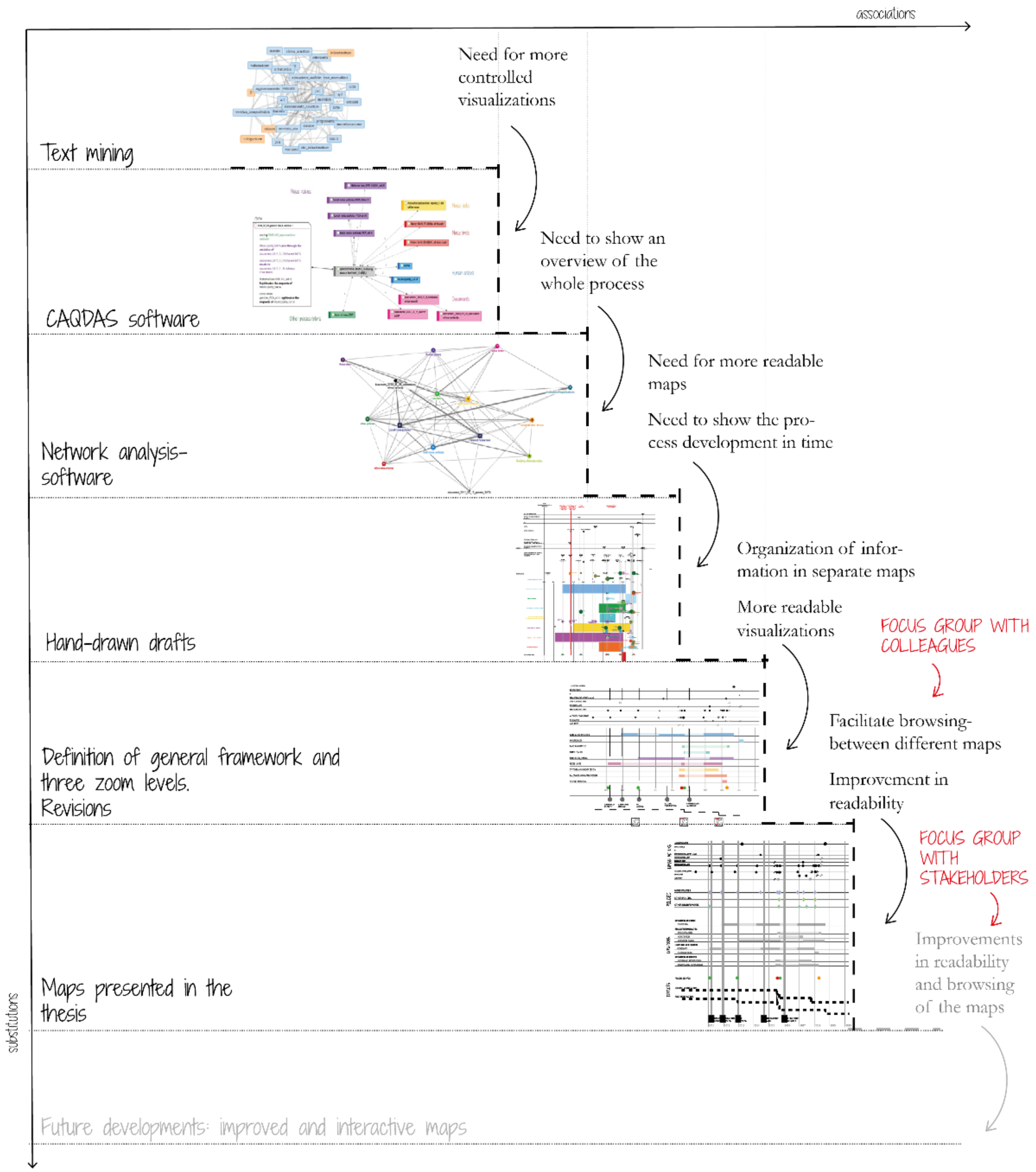


Figure 4.18– diagram of the evolution of the maps. The first three steps involved software-based network visualizations, while the following ones represent the evolution of the hand-crafted maps from the first draft tp the maps presented in this chapter. The last step in the evolution of the maps and the step towards future developments will be further explored in Chapter 7

PART II

Chapter 5

5 Noise regulations in Turin, Italy

Overview

Chapter 5 defines the normative framework which influences the urban transformations in the city of Turin with respect to noise mitigation issues.

Section 5.1 presents the national and regional norms that, started from the national framework law in 1995, defined the modalities for the acoustic regulation of the territory and the related noise limits.

Section 5.2 presents the local regulations that implements the national and regional indications, setting specific requirements for the city of Turin.

Section 5.3 briefly introduces the decrees implementing European directives in terms of environmental noise and Strategic Environmental Assessment, which, although did not have a direct involvement in the selected case-study, might also have a role in the transformation process with respect to noise mitigation requirements (as will be shown in Chapter 6).

Section 5.4 sums up what has been presented in the previous sections, reporting the framework of normative requirements at national, regional and local level regarding noise mitigation fulfilments in urban transformations.

5.1 National and regional laws

5.1.1 The national framework law on noise mitigation in Italy

In Italy, the first attempt to regulate environmental noise at national level was done with a prime minister's decree in 1991[50].

The conditions for a national legislation on noise limits were prepared in the previous decade, when the law 833/1978[51] established the national health service and planned for future laws to establish indication to unify the health conditions in all the Italian territory. Moreover, the law 349/1986[52], following the previous one, established that the ministries of environment and of health should then have set the

[50] Decreto del Presidente del Consiglio dei Ministri del 01/03/1991 "Limiti massimi di esposizione al rumore negli ambienti abitativi e nell' ambiente esterno".

[51] Legge 23 dicembre 1978, n. 833 "Istituzione del servizio sanitario nazionale"

[52] Legge 8 luglio 1986, n. 349 "Istituzione del Ministero dell'ambiente e norme in materia di danno ambientale"

maximum limits of exposure to various kind of pollutant, among which also environmental noise was included.

The decree of 1991 was therefore the first attempt, pending a framework law on the subject, to respond to the afore-mentioned legislative requirements, by setting maximum acceptable limits for outdoor noise levels on the basis of the intended uses of the different urban areas, hence linking for the first time in Italy the noise mitigation issue to spatial planning.

Four years later, the **framework law 447/95 on noise pollution**[53], based on the principles included in the previous decree, **set the general guidelines** for the emission of the successive implementing decrees on the regulation of both indoor and outdoor acoustic environments and **defined the roles of the different administrative actors** in the control of environmental noise. Among them, the state was in charge of defining the noise level limits for the areas of the territory, as well as of setting the criteria for the design, the construction and the renovation of buildings and of transport infrastructures, in order to prevent exposure to high levels of environmental noise.

The regions were asked to set the procedures and criteria that **local administration** had then to follow for the definition of the **Acoustic Classification plans of their territor**y. Moreover, the local administrations were also requested to **control the accomplishment of law requirements with respect to environmental noise protection when granting building permits** and authorizations for productive activities. This control could be established by regulations for the local implementation of the national and regional legislation on environmental noise protection.[54]

5.1.2 Acoustic classification of the territory

The Acoustic Classification plan, key instrument for the fulfilment of the indication of the national framework law, is designed, as previously said, by each municipality for their own territory. In such classification, **the territory is divided into different "classes" on the basis of the intended use of the areas**, **to which different noise level limits are associated**. The local administrations are also required to coordinate the planning regulations already in force with the acoustic classification[55], which underlines the aim of integrated planning of the territory that was behind the framework law. The acoustic classification **is therefore an act of governance of the territory,** as it regulates its use and limits the modalities of its development.

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[53] Legge 26 ottobre 1995, n. 447 "Legge quadro sull'inquinamento acustico"

[54] In the present text, only the activities which are relevant for the examined case study are presented. For a complete overview, see art. 3, 4 and 5 of the law 447/95

[55] L. 447/95

The national DPCM 14/11/1997[56] established the six classes in which the territory ought to be divided on the basis of the expected land uses. For each acoustic class noise limits are defined in terms of LAeq, A-weighted equivalent noise level[57], for daytime and night-time. It is therefore an acoustic regulation of the territory that is linked to the expected land use of the different areas and not to their proximity to infrastructures (as expressed by a technician of the Environment Area in Turin municipality, the acoustic classification of the land "does not see" the infrastructure[58]), for which specific implemented decrees were issued later, as will be shown in the following Subsections.

In the Piedmont region, the **regional law 52/2000**[59] implemented what determined by the national framework law, restating how the acoustic classification integrates the planning regulations in force, and coordinates with them in order to harmonize the land use and the development of the territory with the need to protect the outdoor and living environment from noise exposure (art. 2, c. 1), indicating therefore how **every variation in the planning regulations entails the verification and potential revision of the acoustic classification** (art. 5 c. 4).

A deliberation from the Regional Council of 2001[60] defined then the 5 operative phases for the drafting of the acoustic classification plan, stating once again that the acoustic classification reflects the local administration choices in terms of land use (art. 2 c. 1) and that, according to DPCM 14/11/1997, it does not take into account the infrastructures, that would have been later regulated (art. 2 c. 4). The deliberation acknowledged that such indication equals to the exclusion of the infrastructures in those situations in which the infrastructure typology is "not in line" with the activities which are situated in their proximity.

5.1.3 The implementing decrees for the regulation of infrastructure noise

As said before, the acoustic classification of the territory remains *de facto* "blind" with respect to the infrastructures[61]. **Noise mitigation of infrastructure was then tackled by other three implementing decrees of the national framework law 447/95.**

[56] Decreto del Presidente del Consiglio dei Ministri del 14/11/1997 "Determinazione dei valori limite delle sorgenti sonore"

[57] LAeq is the A-weighted equivalent continuous sound level in decibels measured over a stated period of time. The A' Weighting is a standard filtering of the audible frequencies designed to reflect the response of the human ear to noise.

[58] Interview with a technician of the Environment Area, July 2017

[59] Legge regionale 20 ottobre 2000, n. 52 "Disposizioni per la tutela dell'ambiente in materia di inquinamento acustico"

[60] DGR 6 agosto 2001, n. 85 – 3802 "L.R. n. 52/2000, art. 3, comma 3, lettera a). Linee guida per la classificazione acustica del territorio"

[61] Interview with a technician of the Environment Aerea, July 2017

The first to be emitted was the Environmental Ministry **decree of the 16th March 1998**[62] **that established the measurements techniques and methods for environmental noise,** both outside and inside living environment (attachment B of the decree).

On the 29th November 2000, the same ministry issued then a new decree[63] establishing the criteria and timing for the issuing of plans for the mitigation of environmental noise by societies and authorities in charge of infrastructures (see L. 447/95 art. 10 c. 5).

The decree specifies that the charges deriving from the mitigation interventions are borne by the societies and authorities in charge of infrastructures and that such interventions should be realized preferably acting first of all at the source, then on the propagation path, and finally at receiver, when needed (art. 5 c.4).

The decree also indicates a series of possible interventions, together with the cost estimation and the expected benefits in terms of noise level reduction (attachment 3 of the decree). However, although the municipalities are recognized among the authorities interested by the decree, as in charge of urban infrastructures, **the list of possible interventions are *de facto* designed for motorways and roads outside urban areas.** Of the 15 possible mitigation measures listed in attachment 3 of the decree, 11 are acoustic barriers or infrastructure coverings, which can very rarely be realized within the urban fabric. Other two refer to possible road surfacing, while only two involve interventions on the buildings, referring to finishing interventions that do not involve the design of the building. One of them is indeed the use of sound absorbing cladding on facades, while the other refers to the use of sound insulating windows, implying that, in "particularly difficult situations, which are not completely solvable through interventions on the infrastructure itself"[64] the granting of noise protection can be evaluating considering a receiver located inside closed living environments.

Lastly, **the decree DPR 142/04**[65] **defined the size of the acoustic buffer zones along infrastructures and the related limits** for accepted noise levels for receivers located within such zones according to the type of infrastructure. The decree **transfers to the municipalities the definition of limit values for buffer zones related to urban roads**, in conformity to the acoustic classification "respecting the values defined for the acoustic classification by the DPCM 14/11/1997" (attachment 1 of the decree).

As far as the verification modalities of such limits are concerned, the decree established that noise levels should be measured outside the buildings, at 1 m from the façade "in correspondence of the points of higher exposure as well as of the receivers". It

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62 Decreto Ministeriale del 16 marzo 1998 "Tecniche di rilevamento e di misurazione dell'inquinamento acustico"

63 Decreto Ministeriale del 29 novembre 2000 "Criteri per la predisposizione, da parte delle società e degli enti gestori dei servizi pubblici di trasporto o delle relative infrastrutture, dei piani degli interventi di contenimento e abbattimento del rumore"

64 DM 29/11/2000

65 Decreto del Presidente della Repubblica 30 aprile 2004 n° 142 "Disposizioni per il contenimento e la prevenzione dell'inquinamento acustico derivante dal traffico veicolare, a norma dell'articolo 11 della L. 26 ottobre 1995, n. 447"

also specifies, however, that when the outdoor limits are not reachable, for technical, economic or environmental reasons, it can be set as a target the indoor limit for LAeq at night-time of 35 dB(A) for hospitals and schools and 40dB(A) for dwellings. Such limits should be measured indoor, at the centre of the room, with closed windows, so that the sound insulation properties of the façade can help reaching the desired level.

The decree also underlines how, in case of transformations along existing infrastructures, **the applicant for the building permit for such transformations is in charge of the mitigation measures.**

Finally, it specifies that the mitigation measures at the receiver should be realized according to guidelines to be issued by the Environment ministry, health ministry and infrastructures ministry (art.7).

Such **guidelines, conceived as a sort of completion of the indications provided by the previous decree (DM 29/11/2000), are however still lacking nowadays**, leaving a sort of "grey area", without national unified indications for mitigation solutions in urban areas, as also acknowledged by the Environment Area of the city of Turin[66]

The Piedmont region has basically adopted the national indications, with the deliberation of the regional Council of 2001[67] that, while defining the different phases of the Acoustic classification plan (see previous Subsection), identifies as the last phase the insertion of buffer areas for transport infrastructures, specifying that within the buffer zones the limits set by national decree have to be observed.

5.1.4 The acoustic environment report

Art. 8 of the national framework law introduces the provisional evaluation of the acoustic environment, a report that, **through the use of noise level measurements, analyses the acoustic condition of a determined area**. The framework law specifies that such report is mandatory for the transformations that involve sensitive receivers, among which are listed the realization of dwellings in proximity of sources of noise pollution such as airports, industries and all the type of roads.

In Piedmont, the regional law 52/2000 has then restated what indicated by the framework law, indicating that **the acoustic environment report has to be provided contextually to the building permit request** and that, should the acoustic environment be incompatible with the foreseen transformation, the administration will take into account the provision of **appropriate mitigation measures in order to issue the building permit** (art. 11) (see Figure 5.1).

The deliberation of the Regional Council 46-14762/2005[68] has then established, in accordance with the regional law (art. 3 L.R. 52/2000), the criteria for the preparation of the acoustic environment report. Is also underlined that the aim of the acoustic environment evaluation is to avoid noise levels that are incompatible

[66] Interview with a technician of the Environment Aerea, July 2017

[67] DGR 6 agosto 2001

[68] Deliberazione della Giunta Regionale 14 febbraio 2005, n. 46-14762 "Legge regionale 25 ottobre 2000, n. 52 - art. 3, comma 3, lettera d). Criteri per la redazione della documentazione di clima acustico"

with the use of the area, hence to verify that the noise levels in correspondence to the foreseen receivers do not overcome the limits set by the national decrees listed in the previous Subsections. Moreover, the deliberation underlines, with respect to the obligations for proponents of new transformations, that on the basis of the evaluation of the acoustic environment should be designed and realized the needed mitigation measures, sized according to the reaching of noise limits set by national laws, and that such decrees established that the mitigation measures for transformations realized after the realization of the road have to be designed and realized by the proponent of the transformation.

It indicates that the mitigation measures should be described in the acoustic environment report, together with an estimation of the mitigation provided by each measure and that the local administration can request the conduction of measurement campaigns at the end of the mitigation measures realization, in order to verify their efficacy.

The Regional Council has then further specified[69] that the request of noise mitigation measures to the proponents has the aim to lead to a preventive economic evaluation of such noise measurements, which could result in a disincentive to the realization of dwellings or other sensitive receivers too close to transport infrastructures, hence leading to a more attentive evaluation of the investment and discouraging transformations in highly noise polluted areas.

5.2 Local noise policies

5.2.1 The local Acoustic Classification plan and the rules for transformation areas

The local administration of the city of **Turin has approved the local Acoustic Classification plan on December 201**0, according to the indication of the above-mentioned national and regional laws. The Acoustic classification plan delineates the **division of the local territory into acoustic zones**, according to the classes defined by the national decree DPCM 14/11/1997. It also **defines the buffer areas for the local roads and the related limits**, according to the national decree DPR 142/04, and sets for all the roads the LAeq limit of 65 dB(A) at daytime and of 55 dB(A) at night-time, also in relation to the World Health organization indications[70].

The Acoustic Classification plan is closely connected to the local Masterplan, upon which it is based. It recalls the indications of the regional law L.R. 52/2000, which states that every variation to the general Masterplan of the city needs to be

[69] Deliberazione della Giunta Regionale 11 luglio 2006, n. 30-3354 "Rettifica delle linee guida regionali per la classificazione acustica del territorio di cui all'art. 3, comma 3, lettera a), della legge regionale 20 ottobre 2000, n. 52"

[70] Interview with a technician of the Environment Area, July 2017. The WHO report *Burden of disease from Environmental noise* of 2011 indicated 55 dB(A) as an interim limit level to be reached for night-time noise exposure (World Health Organization (WHO) Europe 2011)

accompanied by a contextual verification of the compatibility of such variation with the Acoustic Classification plan.

The law also indicates the **transformation areas identified by the general Masterplan** (*ZUT = Zone Urbane di Trasformazione* and *ATS = Aree di trasformazione per Servizi*) **as primary occasions for the acoustic mitigation** actions in the city, in which transformations need to be done in compliance with the noise limits set by the Acoustic Classification plan, hence realizing, if needed, acoustic mitigation measures.

As indicated by the employees of the local Environment Area, while in the areas of consolidated urban fabric the monetization of mitigation charges is accepted, in **the case of transformation area the request is to design and realize mitigation measures, proving that they are sufficient to reach the requested limits t**hrough measurement campaigns. As indicated by the interviewee, the idea behind this rule is that, given the higher freedom in design and distribution of the buildings that such areas should have according to the local general Masterplan, there is the possibility to "start from scratch", defining an *ad-hoc* mitigation plan[71].

The rules of the Acoustic Classification plan dedicate a specific section to those areas, indicating that the **compatibility with the Acoustic Classification**, that according to the Regional law has to be verified **in case of variation to the general Masterplan, can entail specific prescriptions and indication of mitigations** to be conducted in order to reach the compatibility with the envisioned destination of the area. Moreover, in case of particularly critical situations it can be required to verify the noise levels of the area through *in-situ* measurements.

5.2.2 The local acoustic regulation

The national framework law 447/95 and the regional law 52/2000 also required to the local administrations to adopt **a local acoustic regulation for noise pollution prevention**. The city of Turin issued such regulation in 2006[72]. Within the regulation, as far as transformation areas in the city are concerned, the art. 24 **requires the acoustic environment report, that the regional law required in the phases of building permit request, also in the case of approval of the executive planning instruments** required to realize such transformations[73], hence "anticipating the problem with respect to the national requirements, with the aim of defining mitigation solutions at the earlier stages of the project[74]

[71] Interview with a technician of the Environment Area, January 2018

[72] Città di Torino, "Regolamento comunale per la tutela dall'inquinamento acustico"

[73] The executive planning instruments (=*Strumenti Urbanistici Esecutivi*) are implementing instruments of the General Masterplan that are required for carrying on transformations in specific areas identified by the masterplan. Such plans can be promoted by local administration or by private proponents. The regional law 56/77 defined the executive planning instruments in Piedmont.

[74] Interview with a technician of the Environment Area, January 2018

Moreover, with respect to new transformations within the buffer areas of roads, the local regulation specifies that the compliance with the limits set by the national decree 142/2004 has to be guaranteed by the proponent of the transformation, and that the compliance of the limit has to be proved in the acoustic environment report.

Figure 5.1 shows a summary of the **steps that a urban transformation process involving noise-sensitive receivers such as dwellings has to undertake in order to be actuated in the city of Turin,** together with the obligations that have to be fulfilled in each step, with respect to environmental noise mitigation issues. In particular, the scheme is referred to a dwelling project in a *ZUT* area, subjected to executive planning instrument, such as the case-study that will be analysed in Chapter 6.

As can be seen in the Figure, the realization of a zoning plan is followed by the executive planning instrument, in which the design of the buildings is developed and detailed, while the realization of the buildings starts with the granting of the building permit. The realization of a whole area can be achieved using one unique building permit or subdividing the area in different allotments, as in the case-study examined in Chapter 6. Both the zoning plan and the executive planning instrument require a verification of compatibility with the Acoustic Classification plan, while an acoustic environment report is required for both the phases of executive planning instrument and building permit granting. In the lower part of the figure are indicated the laws and policies that are involved in such requirements. In particular, the black rhombus indicates the law or policy that established such requirement, while the grey rhombuses indicate the laws or policies which may be involved, by setting further requirements or specifications.

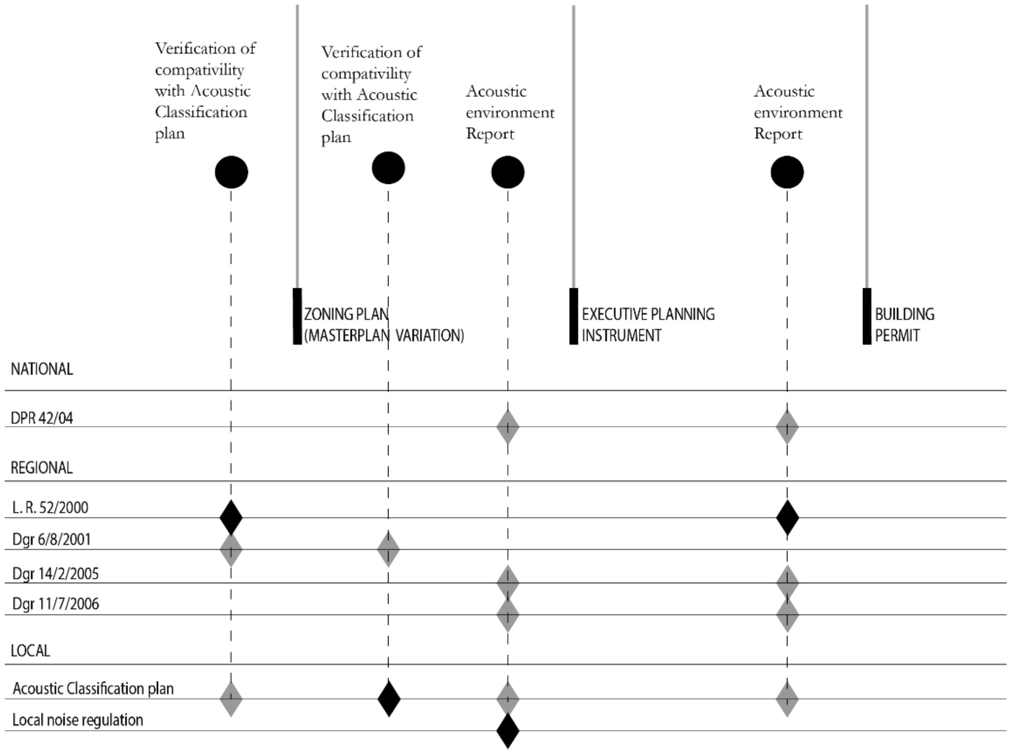

Figure 5.1– Obligations to be fulfilled for each step of the transformation, with respect to noise mitigation requirements

5.3 Additional notes: implementation of the European directives

Beside the national framework law 447/95, Italy has adopted in the early 2000s a series of legislative decrees implementing two different European directives, which may also influence the noise mitigation requirements for urban transformation.

In 2005, the legislative decree[75] implemented the European Environmental Noise Directive[76]. Such decree requires to the municipalities to realize noise mappings of their area, together with action plans for noise pollution mitigation. The city of Turin has realized the first noise maps in 2007, then updated in 2012, while the action plan was adopted in 2013.[77]

Noise maps of the city allowed to individuate the noise produced by all the infrastructures managed by the city, in terms of noise levels at 4 m above the ground on a 5X5 m grid on each road as well as on each façade. The maps showed how the exposure to noise levels higher than the limits set by the local Acoustic Classification plan accounts for about 40% of the population at daytime and about 67% of the population at night-time. On the basis of such maps, the action plan has then defined the actions to be done, identifying priority areas for intervention.

Moreover, another implementation of European directives might be of interest with respect to the compatibility of urban transformations with noise pollution in the interested areas.

The European Directive 2001/42/CE[78] introduced the Strategic Environmental Assessment, in relation to the evaluation of plans and programs on the environment. Such directive has been implemented in Italy by legislative decree in 2006[79] then integrated in 2008[80]

According to the decrees, the preventive evaluation should include information on the compatibility with other planning tools and regulations, including therefore the Acoustic classification plan[81].

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75 D.Lgs 194/05 “Attuazione della direttiva 2002/49/CE relativa alla determinazione e alla gestione del rumore ambientale”

76 Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise

77 Città di Torino, “Piano di Risanamento Acustico Comunale”

78 Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment

79 Decreto legislativo 3 aprile 2006, n. 152 “Norme in materia ambientale”

80 Decreto legislativo 16 gennaio 2008, n. 4 relativo a “Ulteriori disposizioni correttive ed integrative del D.Lgs. 152/2006"

81 The preventive evaluation for SEA applicability can indeed contain reports whihc have already been produced in order to respond to other normative requirements, including therefore the compatibility to the Acoustic Classification plan (D. Lgs. 152/2006)

The Piedmont region, which already anticipated such requirements with the requirements with respect to environmental compatibility set by the regional law 1998[82], has implemented the national requirements in 2008[83], setting operative guidelines and defining the plans and programs to be subjected to the SEA or only to the preventive evaluation of applicability of SEA. In particular, the preventive evaluation is set for variation to the general Masterplans of municipalities and for the related executive planning instruments.

In 2013[84], the Piedmont region introduced specific indications on the SEA procedure for planning instruments, indicating that the local administration is responsible for such procedure. The local administration of the city of Turin has then implemented such indications in 2014[85], assigning to the Environment Area the responsibility for the SEA procedure, with the support of the regional environment agency (ARPA) and all the subjects which might have competencies in environmental issues.

5.4 Summing up

In the present chapter, an overview of laws and regulations concerning environmental noise mitigation has been provided. Three different levels of regulations have been examined: the national framework law and its implementing decrees, the regional and the local regulations, with reference to the city of Turin, in Piedmont region, where the selected case study is located.

In particular, the chapter explained how the environmental noise issue was tackled **in Italy through a general framework law in 1995, which introduced the acoustic classification of the territory** and defined the role of State regions and local administrations in tackling the problem. Different implementing decrees have then been emanated by the central government in order to actuate what foreseen in the framework law. In particular, one decree (DPCM 14/11/1997) established the criteria for the acoustic classification and **related noise levels limits**, while three other decrees (DM 16/11/1998, DPR 142/04 and DM 29/11/2000) tackled the **issue of noise pollution from infrastructures**, which are not comprised in the acoustic classification.

Moreover, the Piedmont region has implemented the requirements of the framework law through a regional law (LR 52/2000) and further clarified different issues through deliberations of the Regional Council. Finally, the local administration of the city of Turin has defined its own regulations, implementing

[82] Legge regionale 14 dicembre 1998, n. 40. "Disposizioni concernenti la compatibilità ambientale e le procedure di valutazione."

[83] Deliberazione della Giunta Regionale del 9 giugno 2008 n.12-8931

[84] Legge Regionale 25 marzo 2013, n. 3 "Modifiche alla legge regionale 5 dicembre 1977, n. 56 (Tutela ed uso del suolo) e ad altre disposizioni regionali in materia di urbanistica ed edilizia.",

[85] deliberazione. 8 gennaio 2014 – 2014 00016/126

the requirements set by the national and regional legislation, through the **local noise regulation in 2006 and the Acoustic Classification plan in 2010.**

The chapter put in light the requirements that a urban transformation process such as the one examined in chapter 6 has to fulfil in the different phases of the process (see Figure 5.1). In particular, a transformation area, for which both masterplan variation and executive planning instruments are required, such as the one examined in the following chapter, requires a **verification of the compatibility with the Acoustic Classification plan in the phases of masterplan variation and of executive planning instrument**, as well as an **acoustic environment report both at the stages of executive planning instrument and building permit request** (see Figure 5.1). Such reports should include the design and evaluation of mitigation solutions that can be sufficient to reach noise levels below the limits set by the Acoustic classification plan, evaluated on the basis of the acoustic environment detected in the area.

Finally, it has been put in light how also the laws implementing the European directives in term of environmental noise and Strategic Environmental Assessment of urban transformations can be involved in the environmental noise issue in in urban transformation processes.

Figure 5.2 shows a schematic representation of the regulatory framework concerning environmental noise mitigation, examined in the present chapter, with a brief note on the aspects of each law and decree which are interested for this work.

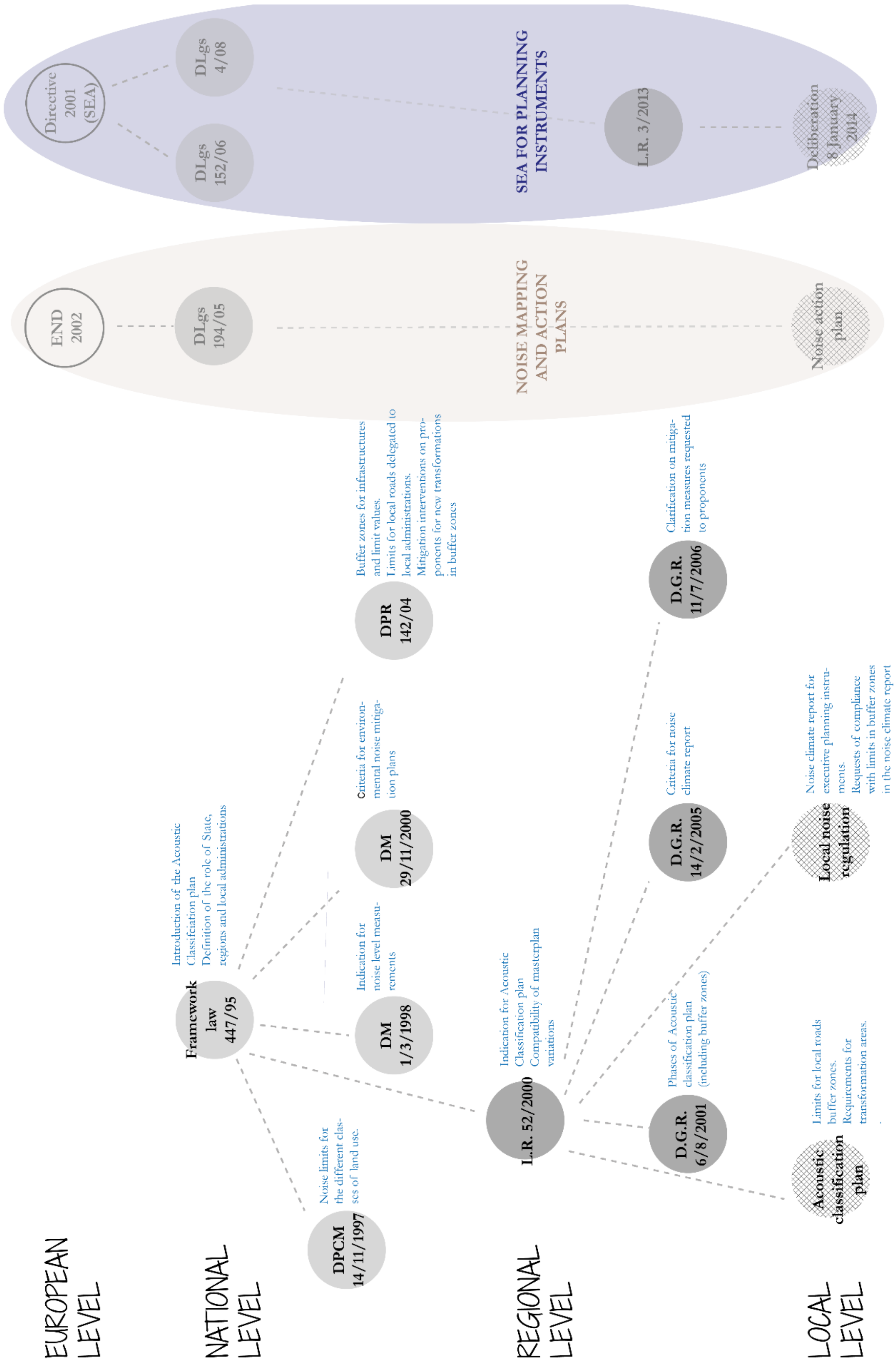


Figure 5.2– Schematic representation of the regulatory framework presented in the chapter

Chapter 6

6 A case study in Turin

Overview

Chapter 6 focuses on the selected case-study of a transformation area in the city of Turin, Italy.

Section 6.1 briefly introduces the area location and characteristics.

Section 6.2 starts the exploration of the process through the maps described in chapter 4, providing a general overview of the process through the main map.

Sections 6.3 to 6.6 examine more in detail the whole process trying to conjugate the chronological narration of the process with the analysis of the different *matter of concern* derived from the analysis. In particular, section 6.3 presents the first phases of the process, up to the approval of the executive planning instrument needed for the transformation, while section 6.4 focuses on the development in time of the concerns relate to mitigation solutions and their material effect on the project. Sections 6.5 and 6.6 presents the later part of the process, towards the granting of the second building permit, exploring the modification in the initial requirements that allowed the process to move on, as well as the arising concerns.

Section 6.7 goes back to a general overview of the process, focusing on the role of noise mitigation policies and on how the local office acted in the implementation of the policies.

Section 6.8 sums up the findings, following the research questions detailed in Chapter 2.

6.1 The development area "*ZUT 13.11 Moncalieri*"

The transformation area *ZUT* (=*Zona Urbana di Trasformazione,* see Subsection 5.2.1) "Moncalieri 13.11" is located in the south-west part of the city of Turin, between the Po river and the hills that delimit the city on the east side. The area is crossed by *corso Moncalieri,* a double-lane avenue that is a fundamental arterial road for the traffic of the eastern area of the city (see. Figure 6.1). Due to the amount of traffic, high noise levels are reported on *Corso Moncalieri,* which is classified in the acoustic action plan of the municipality of Turin (see Section 5.3) as one of the primary areas of intervention.

The avenue divides the transformation area into two parts with rather different characteristics. The foothill area, of about 8.302 m^2, was originally intended, according to the General Masterplan, for green areas and parking lots, a public square and the related connection roads. Such prevision had however been superseded due to further transformations of the surrounding areas (cfr. Figure 6.2a).

The area located between the avenue and the river was mainly comprised within the previous boundaries of the *ZUT "13.11 Moncalieri"*, as defined by the General Masterplan, which was completely destined to public park (see Figure 6.2a). The area was furthermore vastly occupied by many artisan and commercial activities, located within buildings in a poor state of preservation, that impeded the completion of the river bank park (see Figure 6.2a).

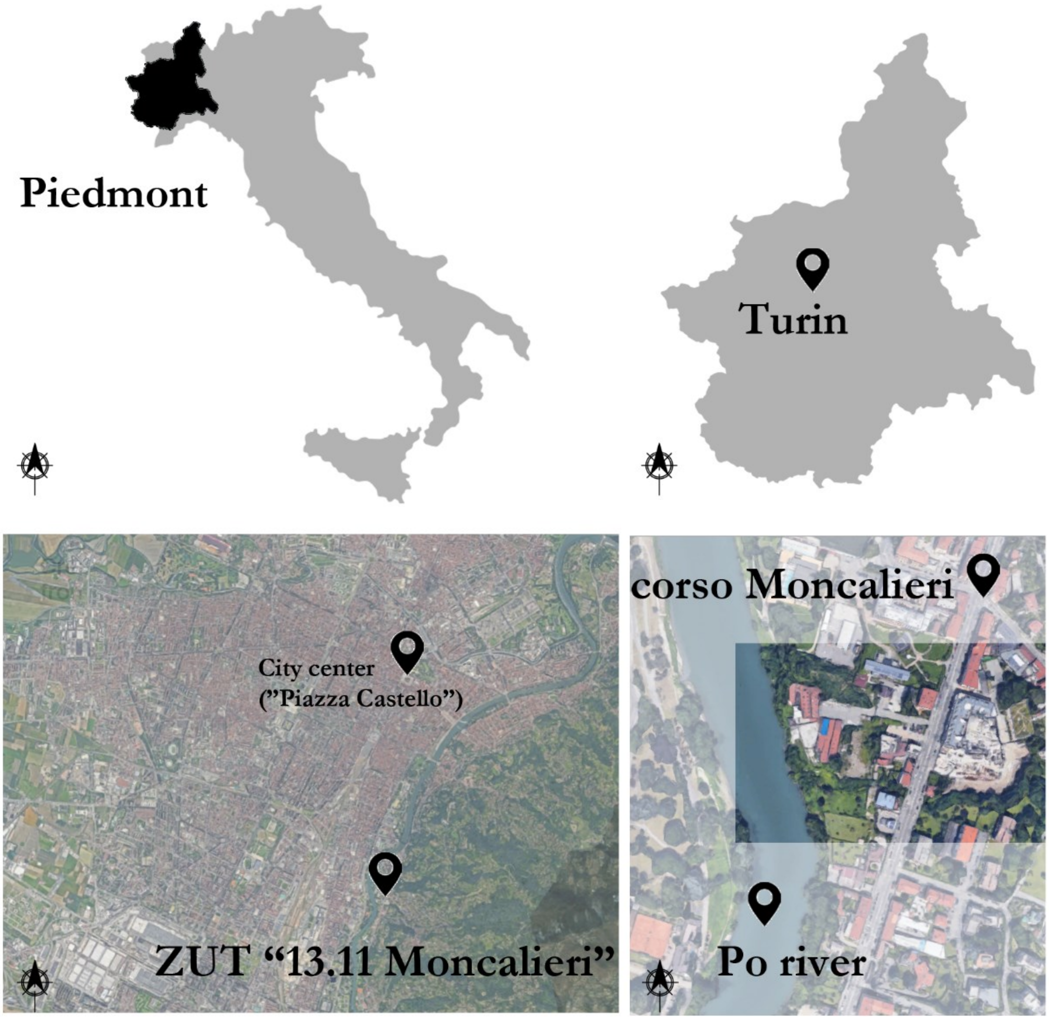


Figure 6.1 – Location of Piedmont with respect to Italy and of Turin with respect to Piedmont; location of the *ZUT "13.11 Moncalieri"* with respect to the city of Turin and to the Po river and the avenue *corso Moncalieri*

The *ZUT* "Moncalieri 13.11" took its actual configuration after a new zoning plan (variation 235 to the General Masterplan) was adopted. The variation request, presented on the 25th February 2010 by private owners who already owned some of the parcels comprised within the examined area, determined the realization of a *ZUT* that comprises all the afore-mentioned areas, for a total area of about 21.270 m^2 (see Figure 6.2b). For such area, residential and partly commercial buildings were envisioned, with the demolition of all the buildings that fell within the river flood buffer zone (except for one historically relevant ones). The proposition comprehends also the free transfer to the municipality of all the area within the river buffer zone, together with access areas and related parking lots (see Figure 6.3a and 6.3b) [86].

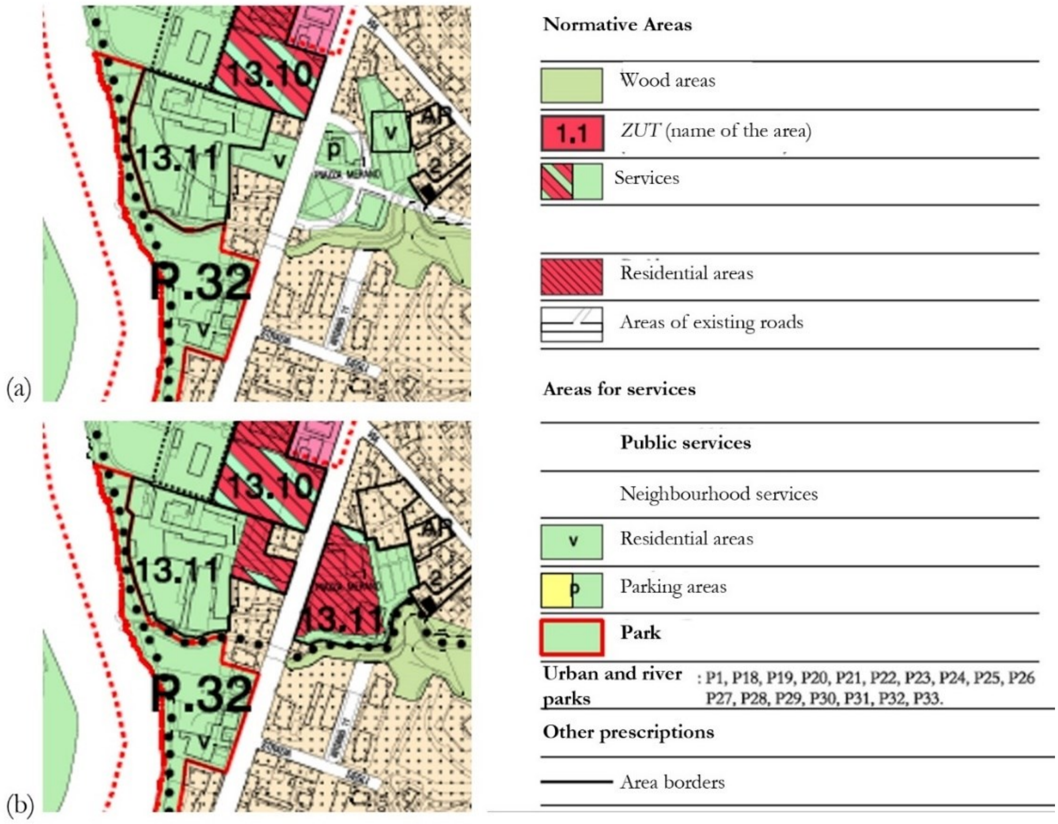


Figure 6.2 - Masterplan rules for the area before (a) and after (b) the Masterplan variation (elaboration of the author on the basis of the documents of the masterplan variation)

The new zoning plan was adopted in March 2011[87], being evaluated as a substantial contribution to the provisions of the municipality for the environmental restoration of the right river bank, started in 2001, and to the relocations of activities in high hydrogeological risk[88].

The previous rules set by the General Masterplan were therefore substituted by new rules, which sets the index of territorial exploitation and defines the admitted quantities of commercial and residential buildings. Among the "additional requirements" set by the new zoning plan rules, that the continuity with the existing buildings was required, hence **placing the new foreseen buildings along the edges of the avenue.**

[86] Explanatory Memorandum of the Zoning Plan; "VARIANTE PARZIALE N. 235 AL P.R.G. (ai sensi dell'art. 17, comma 7, della l.r. 56/77 e s.m.i.) Area del "Molino di Cavoretto"

[87] Città di Torino, "Piano Regolatore Generale di Torino. Norme Urbanistico Edilizie di Attuazione. Testo coordinato al 31/07/2014"

[88] Explanatory Memorandum of the zoning plan

The requirement followed from the indication of the Province of Turin, due to requests set by the provincial territorial plan[89] for new residential buildings in areas of environmental quality[90]. In this way, for the *ZUT "11.13 Moncalieri",* it was almost nullified the flexibility in building disposition that is foreseen by the General Masterplan for the *ZUT*s, independently from what defined by the building code[91].

Such decision would have an impact on further development of the process with respect to mitigation solutions, as will be shown in this chapter.

(a)
(b)

Figure 6.3- (a) The transformation area with indication of the different properties and buildings before the approval of the zoning plan; (b) The use of different parts of the transformation areas as foreseen by the zoning plan (elaboration of the author on the basis of documents of the executive planning instrument)

In order to locate most of the buildings on the right side of the avenue, in continuity with the existing urban fabric[92], an area of about 7000 m^2 owned by the municipality (marked in yellow in Figure 6.3a) was added to the *ZUT* and then

[89] Provincia di Torino, "Aggiornamento ed adeguamento del Piano Territoriale di Coordinamento Provinciale, PTC2"

[90] Determinazione dirigenziale Settore Ambiente e Territorio, città di Torino, n. 40 del 9/2/2011

[91] Città di Torino, "Piano Regolatore Generale di Torino. Norme Urbanistico Edilizie di Attuazione. Testo coordinato al 31/07/2014"; Interview with team manager on the local Environment Area, conducted on 9th August 2017

[92] Explanatory Memorandum of the zoning plan

bought by the private proponent after the new zoning plan was approved in December 2011. The proponent signed also a bank guarantee to commit to pay the valorisation costs to turn the areas into residential ones, so that it could be used to locate the buildings. In this way, **two building areas along the avenue were defined** (pink areas in Figure 6.3b), while the area towards the river was left to park use (light blue area in Figure 6.3b).

The proposal of the executive planning instrument (*PEC = Piano Esecutivo Convenzionato*)[93] for the implementation of the *ZUT*, presented by the proponent on 26th November 2012, involved the construction of about 14000 m^2 Gross Floor Area of residential and commercial buildings, realized as two blocks located towards the avenue. The building on the right side was aligned to the edge of the road, as required by the zoning plan. The *PEC* was approved on 22nd December 2011, and the related agreement between the city of Turin and the proponent was signed on 4th April 2013.

Due to the contingent situation of the building market, **the plan was divided into five allotments**, to be realized through consecutive building permits. The whole transformation process would therefore require **five consecutive building permits**: the first one for the realization of the underground carpark, and the others for the four allotments (Lotto 1-4) of residential and commercial buildings (see Figure 6.4)[94]

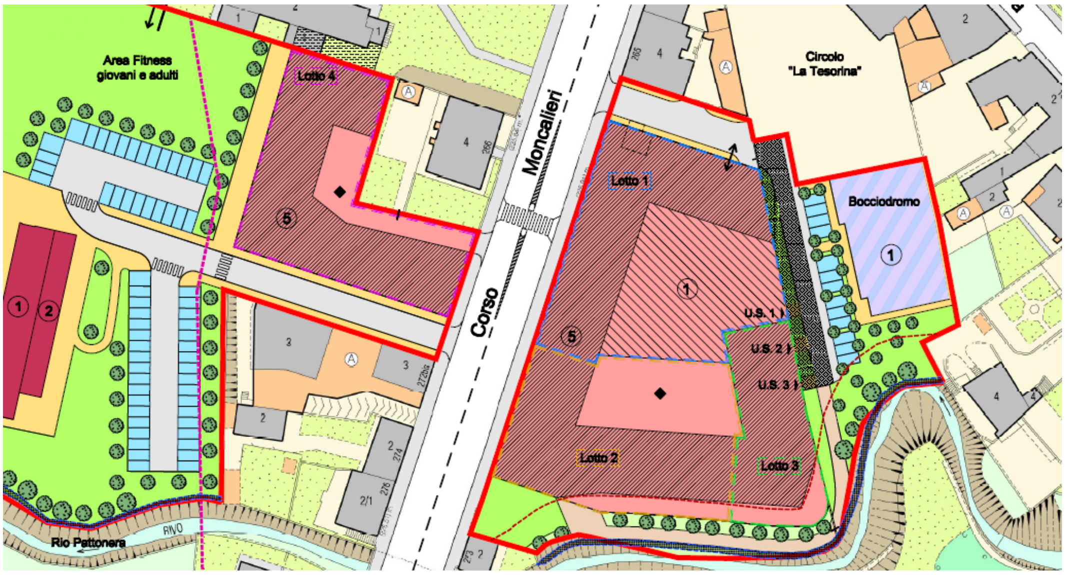


Figure 6.4- The 4 allotments in which is divided the construction of the residential and commercial buildings (extrapolated from the documents of the executive planning instrument)

[93] As seen in Chapter 5, executive planning instruments can be required to actuate transformation of specific areas defined by the General Masterplan. Such planning instruments can derive from public decisions or from private proposal. The planning instruments from private proponents are called *Piano Esecutivo Convenzionato* (=”agreed action plan”), as they imply the signing of an agreement between the proponents and the local administration.

[94] *PEC* Agreement “Convenzione portante approvazione di Piano Esecutivo Convenzionato in Comune di Torino […] Zona Urbana di Trasformazione <<Ambito 13.11 Moncalieri>>”, 4th April 2013.

When the building permits for the residential buildings had to be issued, however, noise reports had to be provided, including the project of the noise mitigation measures, as required by the law (see Chapter 5). The process therefore **collided with some of the noise mitigation requirements that were posed during the zoning plan and the *PEC* agreement, causing a series of controversies**.

Such controversies are investigated in the present research through the methodology defined in Chapter 4, and will be exposed in this chapter through the support of the maps. The aim of this chapter is to answer to the research questions defined at the end of Chapter 2, by putting in light the complex system of (human and non-human) actors, norms and requirements that influenced the application of the noise mitigation policies within the specific process.

6.2 An overview of the process through the "new visual vocabulary"

The exploration of the selected case-study starts from a general overview of the process, which is reported in the map in Figure 6.5. As explained in Subsection 4.3.1, the map reports the process with a specific focus on the noise mitigation issue. On the upper part of the map **("human actors" section) there are the documents produced during the process,** mostly (but not only) in the exchange between the Environment Area of the city of Turin and the proponent. The **"policies" part** presents then an **overview of when noise-related policies or other policies and requirements entered the process**. In the **"concerns" part, each *matter of concern* is represented by a bar**, whose length identifies the duration of the controversy. Finally, in the lower part of the map is reported the **acceptance or refusals of noise reports ("traffic-lights") and the modifications of the building due to the noise mitigation requirements** (see Subsection 4.3.1).

As can be seen in the map, the process followed a "linear" path during the initial phases of adoption and approval of the zoning plan and of the *PEC*. In such phases, the acoustic reports produced by the acoustic consultant, in compliance with the legislation requirements (see Chapter 5), were accepted by the Environment Area, and the completion of each development phase was reached without much controversies (see the documents exchange in the "human actors" section in Figure 6.5, until the "PEC approval" phase). There were already few concerns arising, although they did not have a significant influence on the process at this stage (a detailed discussion on the arguments that have led to this will be given in the following sections).

However, the cloud of documents increased as the proponent issued the documents for the granting of the building permits related to the allotments of the residential building. A couple more exchanges were needed before the granting of the building permit for allotment 1 was allowed. More actors entered the debate as more concerns arose, in particular linked to money issues and to the possibility to act on the building design itself.

The cloud of documents and the collective of involved actors expanded even more when the request of the building permit for allotment 2 was issued. The controversy was partially solved when the Environment Area accepted the granting of the building permit under specific conditions (orange point in Figure 6.5). This will lead to the progressive closure of the controversy, as will be shown in Section 6.6.

Looking at the development of the cloud of documents and of the *matters of concern* through the different phases of the process, it can be seen that it has **a trend that can be considered as opposed to the "comprehensive strategy" proposed by Armando and Durbiano (2017)** (see Subsection 2.3.1), as in this case the complication of the process and of the involved collective increases in the later stages of the process, when the project has already been fixed in many of its aspects by the closure of previous phases (such as the zoning plan and the *PEC* approval).

By looking at the different ***matters of concern*** **(grey bars un the "concerns" section)**, it can be seen how **one of the main debates revolved around the mitigation solutions to be implemented at source**. This gave rise to money-related concerns and to concerns on the timing with which such solutions needed to be implemented (as will be shown in detail in Section 6.4). Other concerns emerged on the levels which have to be taken into account as reference limits, as well as on the testing methods that should be used in order to verify the compliance to such limits. Finally, a part of the debate is dedicated to the **implementation of mitigation solutions at the receiver, through the design of the building, although it has limited material effects on the building itself**, as can be seen in the lower part of the map in Figure 6.5 (se "building modifications" dashed line in the "effects" section of the map). This will be further discussed in Section 6.4).

In the following sections of this chapter, the process will be explored in more details, trying to follow both a chronological order of the events, as well as the focus on different *matters of concern,* actors and moment of the process, through the use of the maps presented in Subsection 4.3.2.

In the following sections, documents named in the text are followed by the acronym with which the document is referred to in the maps. The same acronym is also used in the Attachment 2, where each document is reported in the original version in which it was retrieved (es: [T1]). The number of each documents is unvaried in all the maps.

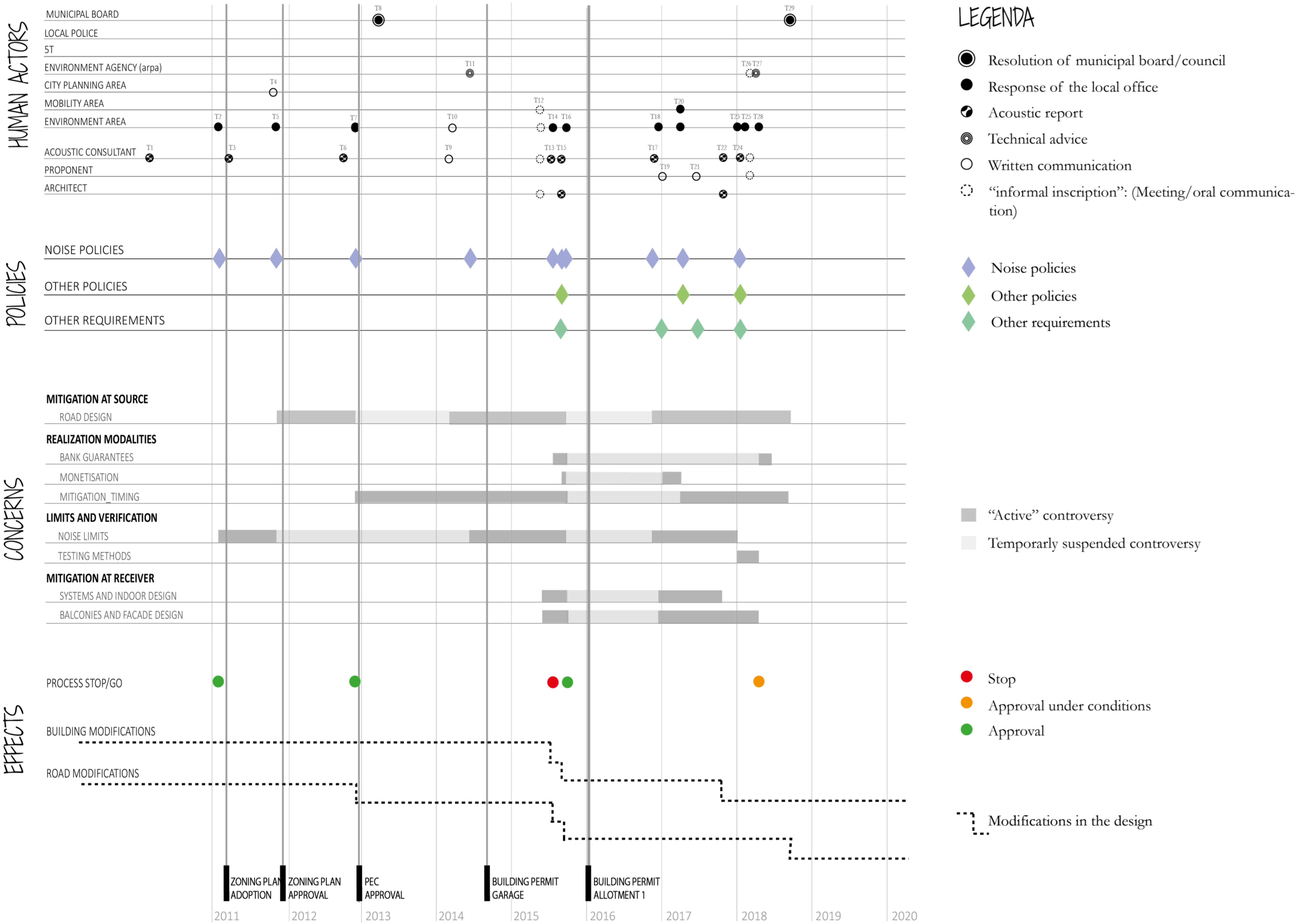


Figure 6.5 - Map of the overall process of "ZUT 13.11 Moncalieri"

6.3 The management of noise mitigation issues in the zoning plan and in the executive planning instrument (*PEC*)

Following what provided for by the regional laws (see Chapter 5), the zoning plan presented for the *ZUT* "13.11 Moncalieri" required the verification of their compatibility with the Acoustic Classification plan, which had in the meantime been adopted by the city of Turin on December 2010, few months after the request for the zoning plan was issued.

The report for the evaluation of such compatibility, compiled by the acoustic consultant [T1-T3], comprehended also an evaluation of the acoustic environment of the area, as required by the rules of the acoustic classification plan (see Subsection 5.2.1).

Since it was not possible, for obvious reasons, to verify the noise level at the facades of the new buildings to be constructed, measures were taken at the road edge, in conformity with DM 16/3/1998 (see Subsection 5.2.1), at about 4 m from the ground. Such measurements put in light a noise level much above the limits set by the acoustic classification plan for the roads buffer zones (see Subsection 5.2.1). In particular, the measured sound levels were of 72 dB(A) during daytime and 70 dB(A) during night-time.

Due to the high noise levels, the response of the Environment Area on the 15th February 2011 [T2], while accepting the compatibility of the variation with the Acoustic Classification plan, also indicated that:

Considering the strong criticality of the acoustic environment of the area, in conformity with art.12 (6) of the rules of the acoustic classification plan, the rules for the development of the area must include that the realization of the transformation cannot be done without the acoustic mitigation of corso Moncalieri*, at least down to the level of 60 dB(A) at night-time, to be verified according to the law.*[95]

Such indication was then implemented in the "particular prescriptions" of the rules set for the *ZUT* during the adoption of the new zoning plan. In the approval phase of the plan, with a response dated 19th December 2011 [T5] that confirms the compatibility with the acoustic classification plan, the Environment Area[96] specified, following a requests of clarification by the Planning Area [T4], that the limit of 60 dB(A) at side road is functional to obtain 55 dB(A) on the facades of the buildings, required by the local Acoustic Classification plan (see Subsection 5.2.1).

[95] In original: *Considerata la situazione di fortissima compromissione del clima acustico dell'area, ai sensi dell'art.12, comma 6, delle NTA del Piano di Classificazione Acustica, si anticipa che la scheda normativa dovrà prevedere quale prescrizione che l'attuazione dell'ambito sia condizionata al risanamento acustico del corso Moncalieri, quantomeno fino al livello limite di 60 dB(A) nel periodo notturno, da misurare con le modalità previste dalla normativa*

[96] The name of the specific office in the city of Turin is *Servizio Adempimenti Tecnico-Ambientali*

The report of the acoustic consultant presented in May 2010 [T1] reported, indeed, the calculation on a 3D model of the foreseen buildings, quite similar to the ones that would be presented in the *PEC*, in which was shown that on the facades, slightly rearward from the street edge due to the presence of vegetated screens (see Figure 6.9), a difference of -5dB(A) could be found with respect to the street edge.

As reported by the Environment Area of the city of Turin:

The first documents related to the Masterplan variation arrived before the approval of the acoustic classification, in which the city has chosen to use the 55dB(A) limit for roads, as it is also the limit suggested by the WHO guidelines[97]. *When the first evaluation of the acoustic climate of the area was done, there was a measuring point in which 70 dB(A) were measured, of course not at the façade as there were not the buildings. So, before the limits of the classification plan were formalized, it was already considered as an ambitious target the 60 dB(A) at the edge of the road. […] then, when was presented the PEC, we had the classification plan, and so we said Ok, but the façade is a bit rearward from the control point, and what was done in the model from the proponents is still valid, so we keep the 60 dB(A) prescription, which becomes 55 dB(A) at façade, that is consistent with the classification plan. We expect an activity of mitigation to be developed during the construction of the buildings [so we needed to keep a control point to check]*[98]

As pointed out by the Environment Area[99], the requirements set for the *ZUT* in the acoustic classification plan draws upon the higher freedom which planners are supposed to have in such areas with respect to the areas into the consolidated urban fabric[100], which are supposed to facilitate the integration of mitigation solutions (see Subsection 5.2.1). However, in this case, the requirements of conformity with the alignment of the pre-existing buildings creates a restriction to this freedom, posing strong limits to the mitigation project.

In order to encourage the mitigation project, the same response of the Environment Area [T5] also contains a first proposal, as a title of example, of mitigation measures which can be realized at source. Such list of measures derived purely from the gathering of previous experience and examples studied by the local office, as no guidelines on mitigation solutions have been issued at national level, as seen in Subsection 5.1.3.

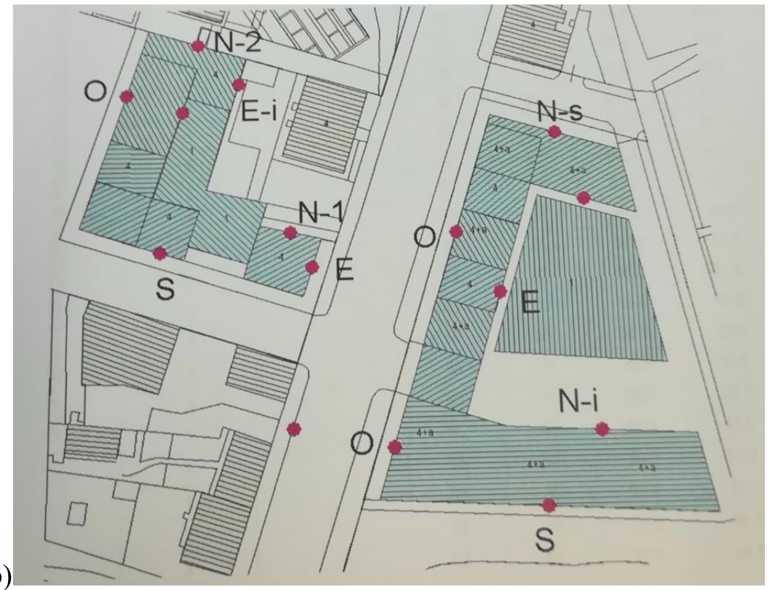
[97] Who guidelines 2009 (World Health Organization (WHO) Europe 2009)

[98] Interview with team manager of the Environment Area, conducted on 9th August 2017

[99] *Idem*

[100] Città di Torino, "Piano Regolatore Generale di Torino. Norme Urbanistico Edilizie di Attuazione. Testo coordinato al 31/07/2014", art. 15

(a)



(b)

Figure 6.6 - (a) 3D model of the proposal as presented in the Masterplan variation; (b) Measuring point R and receivers placed in the 3D simulation model. The receivers O are the ones for which a difference of -5dB was found with respect to R. (extrapolated from the verification of compatibility with the Acoustic classification plan, May 2010)

At the stage of *PEC* proposal, it was then presented an acoustic environment report [T6], as required by the local noise regulation (see Section 5.2), in which the developer proposed the realization, at its responsibility and expenses, of a lit pedestrian crossing as a mitigation measure to reduce car speeds and hence noise. The proposal was based on a previous project of the local administration, which envisaged the realization of a series of similar crossings on *corso Moncalieri*.

With a response dated 20th December 2012 [T7], the Environment Area, while accepting the pedestrian crossing, evaluated it as insufficient to answer to the mitigation needs and suggested again a list of possible measures at source, such as sound absorbing asphalt and messages to increase awareness and reduce cars speed, to be verified through long-term monitoring campaigns, both *ante* and *post-operam*.

As a guarantee for the realization of the needed mitigation measures, the same response also established that the agreement between the municipality and the proponents for the *PEC* should limit the release of the building permits for allotments 2, 3 and 4, as well as the recognition of viability for the allotment 1, to the realization and verification of the mitigation measures.

The project of such mitigation solutions was however not set as a fundamental requirement for the approval of the *PEC*, and the Environment Area agreed with the prosecution of the process, on condition that the agreement was modified as requested. Only two days after the emission of such response, on 22nd of December 2012, the regional council approved therefore the *PEC*. The requirements of the Environment Area would be later included in the art. 12 bis of the agreement, signed on 4th April 2013 [T8].

Figure 6.7 shows an highlight on the part of map related to the first phases of the analysed process, until the approval of the *PEC*. As can be seen, the cloud of documents related to the acoustic mitigation issue is composed by an almost “linear” exchange between the proponent and the Environment Area, in which for every phase of the process there is the production of an acoustic report from the proponent, according to law requirements, and the related response from the Environment Area, which agreed with the prosecution of the process.

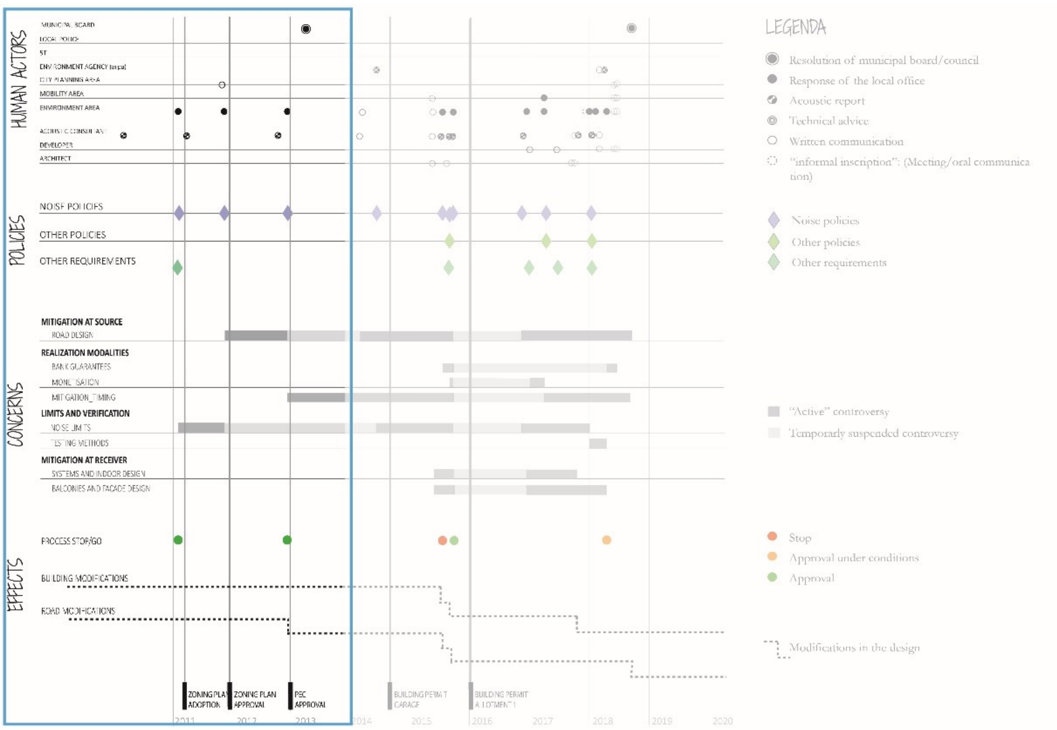


Figure 6.7 - Map of the process highlighting first phases of the process: adoption and approval of the Masterplan variation and approval of the *PEC,* along with the related documents, the arising concerns and the effects on the project

However, through close reading of such documents, it has been put in light in this Subsection the arising of some *matters of concern* during these phases, with the set of some limits, which will be the basis of the controversies that will take place in the next phases of the process. Moreover, some mitigation measures at source started to be explored and discussed, although they did not determine a stop of the process. Such controversies will develop at the stages of building permit requests, as will be shown in the following Subsections.

6.4 The controversies on possible mitigation solutions and the effects on the project

6.4.1 The request of the building permit for allotment 1 and the approval of a "partial" solution

After the signing of the *PEC* agreement and the granting of the first building permit related to the underground carpark (18th September 2014), between spring and autumn 2015 the exchange between the proponent and the Environment Area was opened again, as the request for the building permit of the first allotment of residential buildings was issued.

After a request of clarifications from the new acoustic consultant on the response given by the Environment Area on the *PEC* approval [T9], with respect to the suggested mitigation solutions, and a consultation of the regional environment agency (*ARPA)* [T10-T11], on 29th May 2015 a technical panel was held between architects, acoustic consultant, Environment Area and Mobility and Infrastructures Area [T12]. In the panel, a new list of possible interventions was proposed, such as the use of sound absorbing asphalt. Moreover, for the first time in the process, interventions on the building itself were listed, such as the use of mechanical ventilation and intervention on the façade design (double skin, verandas, etc).

On July 2015, the proponent presented the first report on the acoustic environment of the area, with proposed mitigation measures [T13]. However, it did not integrate the requirements expressed during the technical panel, maintaining the proposal of the lit pedestrian crossing and adding only the proposal of a sound absorbing asphalt (*Splittmastix Asphalt - SMA*). Therefore, on 31st July 2015 a new response from the Environment Area [T14] required further integrations, restating the requests of the panel, adding the request of moving sleeping rooms towards the inner courtyard and of providing bank guarantees as pledge covering the realization of the whole mitigation measures.

The new reports provided on September 2015 [T15] integrated the requests of mechanical ventilation and the use of a different type of asphalt, as emerged during the panel. However, it also presented the remarks of the architects in charge of the project regarding the possibility to intervene on the façade of the building (see Subsection 6.4.3). It moreover contested the request of bank guarantees, given that the *PEC* agreement already limited the granting of new building permits to the realization and test of all the mitigation measures, and that it already required bank guarantees for the infrastructure works, of which the mitigation measures at source are part.

With a response on the 23rd September 2015 [T16], the Environment Area agreed with the granting of the building permit for allotment 1. The response reported that, given that the rules of the Acoustic Classification plan (art. 5 c.3) state that the noise mitigation has to be realized together with the transformation, the mitigation could be divided in subsequent allotments, following the area transformation. The granting of the building permit was therefore accepted, without requiring the complete project of all the mitigation measures for the whole transformation. The response did not modify the requirements of the *PEC* agreement, although softening somehow the requirements of previous responses, which required a complete mitigation project for the granting of the building permit for allotment 1.

"*Those are all decisions taken by our local office"* reported the Environment Area[101], "*as we are moving in a field which is not ruled, since the division of transformations in allotments started after the slowing of the market industry, after the economic crisis. So we said, if the first allotment occupies the 50% of the street edge, and the second one 30%, and the third one 20%, and I have to reach a total reduction of 10 dB, then 5 dB will be assigned to the first allotment, Those 5 dB have been assigned to the first allotment. So you do the asphalt, you test it, and when we reach the 5 dB reduction then we can move on."*.

The Environment Area also accepted to keep the bank guarantees for infrastructure works without additional ones for mitigation measures. The building permit for allotment 1 was therefore granted on 18th January 2016, with integration of the above-mentioned prescriptions. However, the controversies were just temporarily suspended, as the realization of the acoustic asphalt would rise new controversies during the requirements for the new building permit (see Figure 6.8).

[101] Interviews conducted on January 2018 and on July 2018

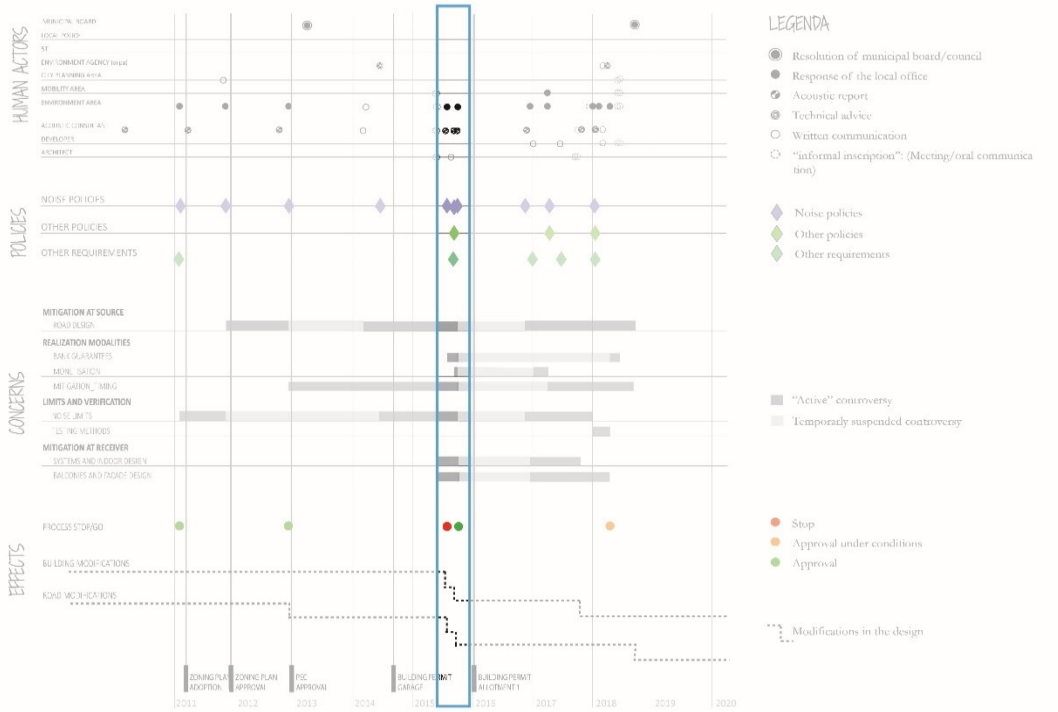


Figure 6.8 - Map of the process highlighting the phase of the agreement on the building permit for allotment 1, along with the related documents, the arising concerns and the effects on the project.

6.4.2 The *matter of concern* of mitigation solutions at source and the related controversy on money and realization timing

Little more than a year later, when the proponents presented the request for the granting of the next building permit (allotment 2), with the related acoustic environment report [T17], the response of the local Environment area [T18] put in light how sound absorbing asphalt had not been verified nor realized.

The realization and test of the asphalt before the ending of allotment 1 had indeed proved to be incompatible with the timing of the prosecution of the building site, and in particular with the completion of the underground utilities related to all the allotments. On 12th January 2017, a communication of the proponent [T19], while still declaring the availability to realize the asphalt as required, underlined how:

"*The work would be soon and repeatedly ruined by the necessary works for connections [to underground utilities] of the buildings realized with the following building permits[…] reducing therefore the benefits.*

We propose, therefore, to monetize the costs foreseen for the realization of the asphalt […] with related decay of the obligations as stated in the PEC *agreement, so that the administration can realize the asphalt with a better timing".*[102]

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[102] In the original: *"Con la presente vorrei, però, evidenziare come tale opera sarebbe presto e ripetutamente rovinata dalle obbligatorie operazioni di allaccio degli edifici oggetto dei successivi Permessi di Costruire[…]riducendone pertanto i benefici. Propongo, quindi, la monetizzazione da parte [del proponente]*

In an interview conducted in August 2017, the proponent further expanded what reported in the communication, estimating that, should the asphalt be realized within the requested timing, it would then be broken about 11 times to connect the building to all the needed services, considering the presence in the area of an electric energy distribution substation that would have to be moved. Moreover, it added that the situation was further complicated by the cuts in the asphalt that would be required by an adjacent building site, of which he could not predict the timing and entity. Furthermore, the realization of the required asphalt would need to be coordinated with the production timing of the asphalt producer, who would need to stop the entire production of normal asphalt

"So, since this one, contrary to the normal asphalt, can be applied in winter, they would produce it in January-February. This implies that, if you skip those months due to the timing of the construction site, or other requirements, you will have to wait until the next year"[103].

The Mobility and Infrastructure Area and the Environment Area replied then to the communication on 5th April 2017 [T20], stating that, although they considered as "reasonable" the request of the proponent, they evaluated how the monetization would not satisfy the *PEC* agreement, nor the norms, as it would transfer to the administration the risks related to the construction and testing of the mitigation measure, which are instead a responsibility of the proponent.

Such response leaded to a temporary stop in the process. As explained by the acoustic consultant:

"*The administration basically said that from a logical point of view, the developer is right. However, from a point of view of laws and agreements, we are in a difficult position, as they told the developer that they can have the next building permit only if they provide the verification of the mitigation interventions. But if they cannot do the mitigation, they cannot test it, and so they cannot have the building permit, we are in a dead-end road, we stopped there"*[104]

Figure 6.9 shows a visualization of the network of actors that were involved in the discussion that developed around the monetization issue. In this case, it is a controversy that has a quite limited duration in time, but it involves a certain number of actors belonging to different categories and is crucial in determining the development of the process. Following the steps of analysis defined in Chapter 4 (*matters of concern,* actions and actors, see also Figure 4.6), the map shows how the debate is linked to many different actors which go beyond the acoustic ones. In particular, the *matter of concern* (red label on the left side of the map) is linked to

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degli oneri relativi alla posa del Rubber Asphalt [...] con decadimento dei successivi obblighi di cui all'art. 12bis della Convenzione, affinché la città possa eseguire il suddetto lavoro in tempi più consoni".

[103] Interview conducted on 3rd August 2017

[104] Interview conducted on 28th February 2018

two main actions, namely the proposal and refusal of monetization of acoustic asphalt (grey labels).

Each of the two actions is linked to a cloud of actors involved in it that includes the human actors and organizations performing such actions (blue labels) but is not limited to it. The proposal of monetization from the proponent was motivated by other requirements (green labels), in particular by production times of the asphalt and by connection with underground utilities, which are in turn more complex due to specific characteristics of the contest (greenish labels). The proposal is also supported by the considerable cost of the sound absorbing asphalt, which, as said would need multiple remakes if done before the second building permit. The motivations linked to the response by the local offices are mainly linked to noise mitigation norms and rules, both at national and regional level (violet labels) and at local level (purple labels), that requires the realization of mitigation measures by the proponent, without the above-mentioned risk transfer to the administration. This is particularly true since art. 5 of local noise policies set specific requirements for transformation areas identified in the local Masterplan (light green label). The refusal also involved the PEC agreement (pink label), in which the building permit of allotment 2 is dependent form the achievement of a certain performance (reduction of noise level) by the project realized by the proponent.

This supports what discussed by the employee of the Environment Area[105], underlining the "asymmetry of information" between local offices and private developers and as while the formers are "*Blind towards the market dynamics, land values, and so on"*, the latter *"tend to ignore the environmental constrains",* and each parts *"relies on their own part of knowledge in the negotiation",* hence showing on a real case study the **different "frameworks of interpretation"** introduced in Chapter 2. The cloud of non-human actors make therefore visible the "values", the concerns that constitute the "cosmos" of the different human actors involved in the debate (Venturini 2012).

[105] Interview conducted in January 2018

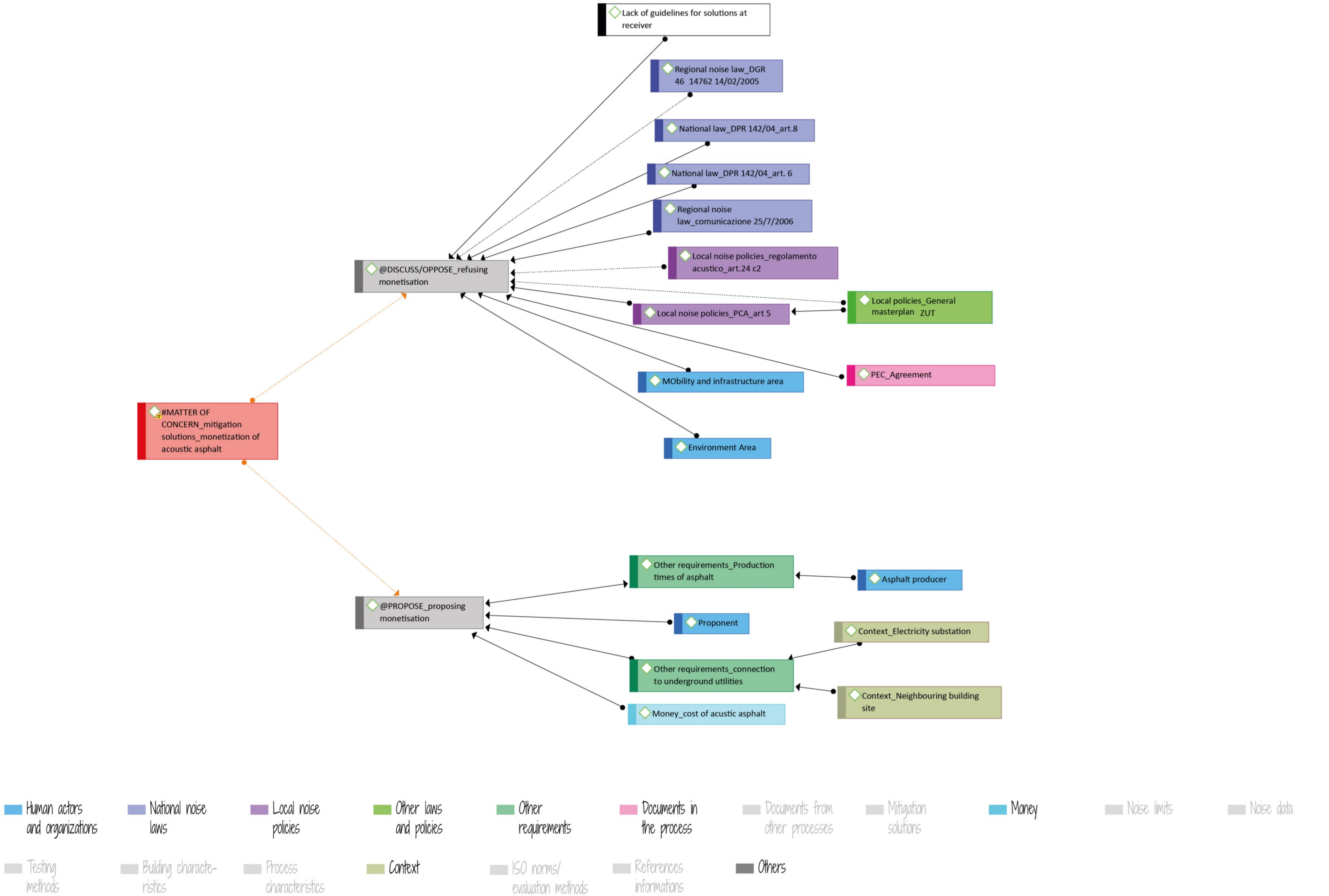


Figure 6.9 - Visualization of the discussion on the monetization of the sound absorbing asphalt. (a) matter of concern extracted from interviews and archive documents, connected to the related quotations; (b) actions linked to the discussion of this specific matter of concern are added; (c) the cloud of human and non-human actors involvein the process: the different colours identify categories of actors.

The response issued by the local offices on 5th April 2017 [T20] proposed then, as a possible alternative, to reschedule the mitigation interventions, with the realization and testing, as portion of mitigation related to the allotment 1 of the info-mobility interventions already proposed in previous responses.

However, this option would bound the next building permit to the realization of works which, although paid by the proponent, have to be necessarily realized by the administration. Therefore, with a new communication on 28th June 2018 [T21], the proponent opened the debate again, proposing to modify the *PEC* agreement, so that the completion and verification of the mitigation measures could be linked to the recognition of viability for the fourth and last allotment of buildings, making themselves available to release a specific bank guarantee (see Figure 6.10b).

The new acoustic report of the 25th October 2017 [T22] integrated then part of the required solutions at the receiver, as shown in the following Subsection, while living substantially unvaried the proposal of mitigation solution at source, underlying once again how measures as the synchronizing of traffic lights or the portal with messages for drivers are not directly feasible for the proponent, and how it is therefore difficult to grant their realization within a schedule that can be compatible with the timing of the construction site, and asking again for the modification of the *PEC* agreement.

The response given by the Environment Area on the 11th January 2018 [T23] restated however the requirements of the previous response, requiring again the realization and verification of mitigation measures for allotment 1.

Although the response set an important turning-point in the process, by modifying the reference noise limit, as shown later in Section 6.5, the controversies on mitigation measures at source and on realization timing of such measures was definitely solved only by the modification of the *PEC* agreement on 28th September 2018 [T29], as will be shown in Section 6.6.

Figure 6.10 reports a visualization of what was presented in this Subsection. The maps reported in Figure 10 are of the “concern” type, as explained in Subsection 4.3.2, which allow to explore more in depth the evolution of each concern. In particular, Figure 6.10a focuses on the *matter of concern* on typologies of mitigation solutions to be realized at source (“road design”), while Figure 6.10b focuses on *matters of concern* related to realization timing and modalities of such mitigation solutions.

In Figure 6.10a, it can be seen how the controversy on mitigation solutions at source is present since the first phase of the process, and persist through the whole process until the modifications of *PEC* agreement [T29]. It becomes active (darker colour in the bar) in each bureaucratic phase in the process (i.e. the *PEC* adoption, the granting of the building permit, etc… see grey vertical bars in Figure 6.10). When the first acoustic report for the approval of the planning instrument or for the granting of building permit is issued the controversy becomes active, and is temporarily closed and becomes latent (lighter colour in the bar) after an agreement is reached and the permission/plan is approved.

Below the bar of the *matter of concern,* are listed all the mitigation solutions at source that were considered during the process. Six solutions are listed, of which 4 solutions aim at tackle vehicle speed (namely the traffic light synchro, the portal with messages to increase drivers awareness, the lit pedestrian passage in front of the building and the speed indicators) while 2 others refer to the sound absorbing asphalt required during the process.

On the line corresponding to each mitigation solution indications are reported of the time during the process in which they were proposed (black arrow), accepted (green tick) or opposed (red X).

As can be seen, each successful translation (green ticks) of noise mitigation solutions into the project implies a material effect on the project (see “road modification” dashed line in the “effects” section of the map), as well as the temporary or definitive closure of the controversy (the grey bar of “road design” *matter of concern* becomes lighter or ends in case of [T29]). As can be seen in the map, the only solution that is accepted, hence integrated in the project, before the *PEC* approval is the pedestrian passage, to which sound absorbing asphalt is added before the granting of building permit for allotment 1. However, as explained in Subsection 6.4.1, the controversy is only temporary closed, as the two mitigation measures are not enough to reach the noise mitigation required for the whole process (and issues on realization modalities are raised as previously explained and as visualized in Figure 6.10b). The more the process goes ahead, the more the number of exchanges needed to reach a successful translation increases.

As far as actors influencing the translations are concerned (“non-human actors” section on the right side of Figure 6.10a), it can be seen that the only actors involved in the discarding of possible solutions are the need to demand the realization to local administration in case of traffic lights synchronizing and of the portal with messages for car speed reduction (grey column in the “non-human actors” table). Indeed, such measures cannot be realized by the proponent themselves, but, although the costs are borne by the proponents, the realization need to be done by the local offices and the 5T mobility agency. Therefore, the realization timing would not have been compatible with the timing of the building site. Indeed, the portal and speed indicators solution were accepted and included in the process only with the modification to *PEC* agreement that, instead of binding the building permit for allotment 2 to the realization and testing of all mitigation measures, required just the ordering and payment of the portal from the proponent (brown column in the table) and the installation of speed indicators, without posing limits on their mitigation results (orange column), hence modifying also the timing of mitigation solutions realization, as shown in Figure 6.10b (this will be further expanded in Section 6.6).

On the other hand, the asphalt realization is supported by the quite high expected noise reduction (yellow column in the non-human actors table), provided by previous test on other areas (lilac column) and estimated on the basis of vehicle speed survey conducted in the process (pink column), and by the road shape and characteristics (greenish column) that have limited space for other solutions.

However, the timing established for the realization of such mitigation solution, whose realization and testing was required before the granting of building permit for allotment 2 (see Subsection 6.4), due also to the rules set in the *PEC* agreement (see Section 6.3 and Subsection 6.4.1) leaded to the *matter of concern* explored in Figure 6.10b.

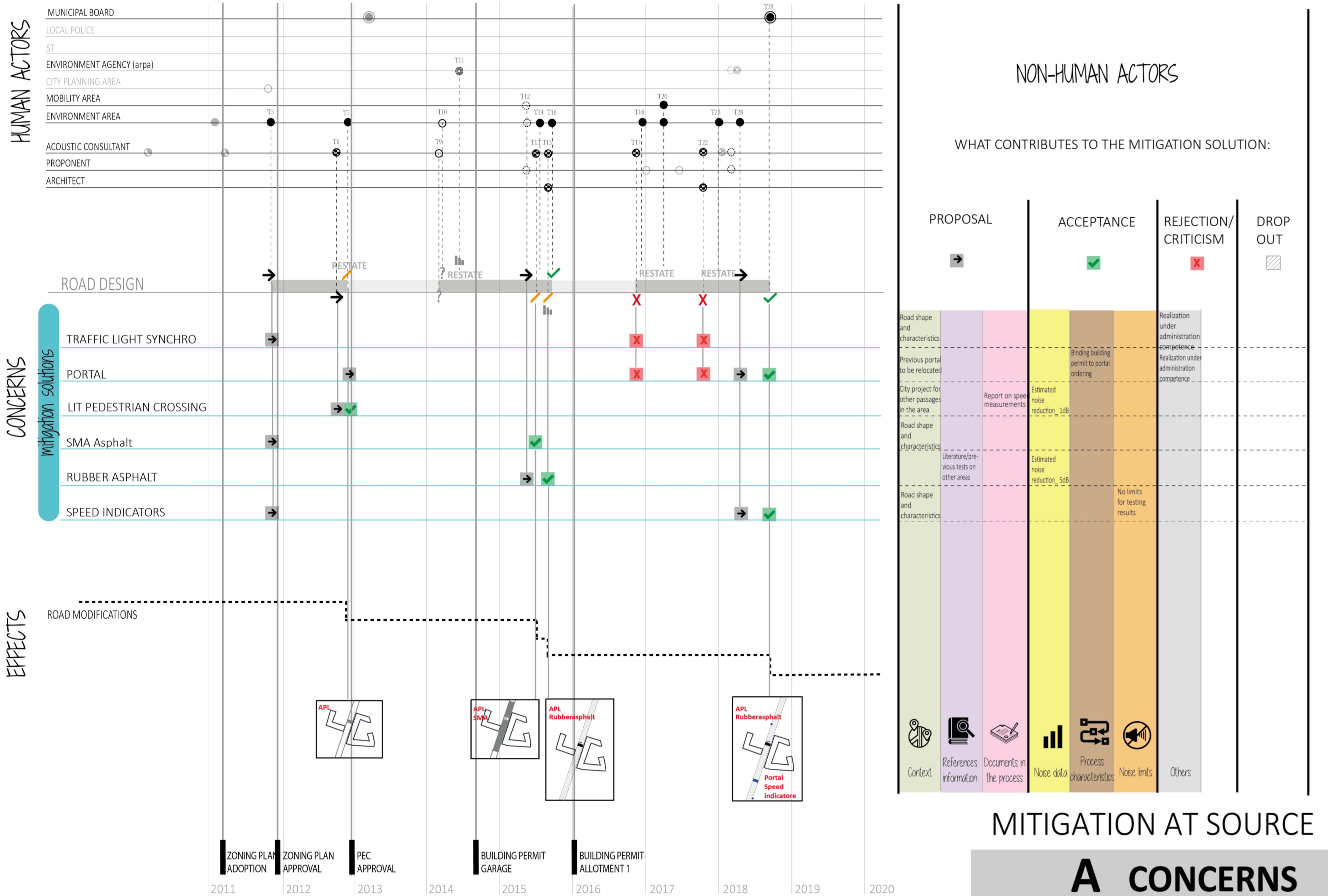
Figure 6.10b focuses on the *matter of concern* of realization timing and modalities of the mitigation solutions. The three concerns are closely connected between them and to the one presented in Figure 6.10b.

By looking at the "mitigation timing" *matter of concern* (lower part of the map) it can be seen how the concern was opened when the first limit was set by the Environment area response in December 2012 [T7], then accepted in the *PEC* agreement, that bound the practicability of the allotment 1, as well as the following building permits, to the realization and testing of all the mitigation measures foreseen by the project. Hence, the proponent had to prove that the requested noise mitigation had been completely reached in order to move beyond the building permit for the first allotment. Such requests is reported as the first of the mitigation timing "solutions" that were posed in the process (first line below the "mitigation timing" concern grey bar). The actors that motivated it ("non human actors" table on the right side of the map) were the requirements set by the national DPR 142/04 (violet column) and by the local Acoustic Classification plan (purple column), as well as the project division in different allotments (brown column), related to crisis in the building market (grey column) and, most of all, the limits set by the documents issued in the previous phases of the process (*PEC* agreement), hence posing binding limits in the first phases of the process, before the mitigation solutions were designed.

However, the requirements were then modified the first time for the granting of the building permit of allotment 1, in which the Environment area accepted a partial project of the mitigation solutions (see Subsection 6.4.1), including only the lit pedestrian passage and the asphalt, postponing the design of the other solutions to the granting of the second building permit. This was decided, as put in light in Subsection 6.4.1, due to the project division in different allotment (brown column in the "non-human actors" table) that leaded to consider a reduction of 5+1dB provided by the two solutions (yellow column) as satisfying for the allotment 1, and to the local policies (purple column) that allowed such decision.

However, the difficulties in the realization of sound absorbing asphalt, as previously seen, leaded to the proposal of monetization of the solution by the proponent [T19], which was however opposed by the local Environment area and Mobility area [T20] (see Figure 6.9). Following such refusal, the same issues with the asphalt realization leaded to the proposal of a modification to the limits posed by the *PEC* agreement, postponing all the mitigation solutions realization and test at the end of the building construction, before the practicability of the last allotment (third line in the "solutions" list for the *matter of concern* of mitigation timing, in Figure 6.10b). This was however not immediately accepted. The limits to the building permits and practicability of the allotments were however modified later, and the concern was finally closed with the reaching of an agreement on the modification of the *PEC* agreement [T29], as will be further explored in Section 6.6.

What presented in this subsections leads therefore to point out how noise mitigation solutions at source are expected to involve different actors and organization in the process. Given the high levels of noise migration that they can provide, they may be good solutions to be included in the process, **provided that they are part of a project defined at the early stages of the process, in which the requirements for realization timing of mitigation solution are coordinated with the other requirements of the building site**.



HUMAN ACTORS
MUNICIPAL BOARD
LOCAL POLICE
5T
ENVIRONMENT AGENCY (arpa)
CITY PLANNING AREA
MOBILITY AREA
ENVIRONMENT AREA
ACOUSTIC CONSULTANT
PROPONENT
ARCHITECT
T5
T6
T7
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
T20
T22
T23
T28
T29
ROAD DESIGN
RESTATE
CONCERNS
mitigation solutions
TRAFFIC LIGHT SYNCHRO
PORTAL
LIT PEDESTRIAN CROSSING
SMA Asphalt
RUBBER ASPHALT
SPEED INDICATORS
EFFECTS
ROAD MODIFICATIONS
APL
APL SMA
APL Rubberasphalt
APL Rubberasphalt
Portal
Speed
indicatore
ZONING PLAN ADOPTION
ZONING PLAN APPROVAL
PEC APPROVAL
BUILDING PERMIT GARAGE
BUILDING PERMIT ALLOTMENT 1
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
NON-HUMAN ACTORS
WHAT CONTRIBUTES TO THE MITIGATION SOLUTION:
PROPOSAL
ACCEPTANCE
REJECTION/ CRITICISM
DROP OUT
Road shape and characteristics
Previous portal to be relocated
City project for other passages in the area
Road shape and characteristics
Road shape and characteristics
Literature/previous tests on other areas
Report on speed measurements
Estimated noise reduction_1dB
Estimated noise reduction_5dB
Binding building permit to portal ordering
No limits for testing results
Realization under administration competence
Realization under administration competence
Context
References information
Documents in the process
Noise data
Process characteristics
Noise limits
Others
MITIGATION AT SOURCE
A CONCERNS

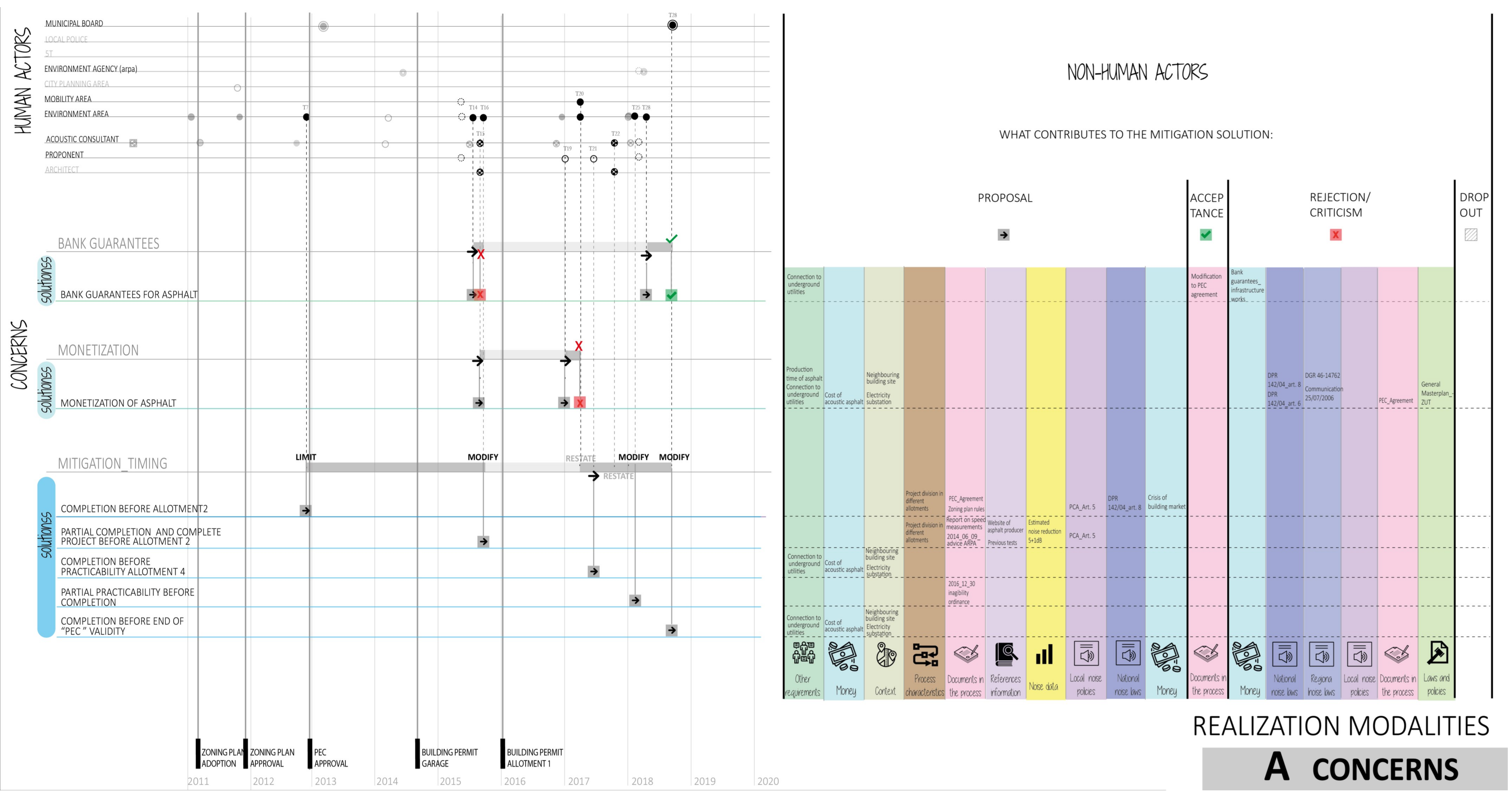


Figure 6.10- (a) Maps of the *matter of concern* which involves the definition of mitigation solutions at source; (b) The *matter of concern* which involve the realization modalities of the mitigation solutions at source: monetization of the asphalt, the use of bank guarantees for the asphalt and the realization timing of the solutions.

6.4.3 The *matter of concern* of mitigation solutions at receiver, through the building design

Contextually to the controversies on possible mitigation solutions at source and their realization modalities, the technical panel held on 29th May 2015 [T12] opened another controversy, closely connected to the previous ones. Among the possible mitigation solutions that could be realized in order to reach the noise mitigation required for the whole project, the panel proposed, for the first time in this process, the use of mitigation solutions at the receiver (i.e. at the location of the future inhabitants, hence on the building itself), with impacts on the building design. The suggestions of the panel involved:

" - *The use of sound-absorbing claddings and materials on the façade, in order to minimize the reflections on the future facades;*

- *De re-evaluation of the façade typology, including a double skin to protect the living environments, […];*

- *The definition of the systems to be put in the buildings in order to maximize the internal comfort (e.g. mechanical ventilation and climatization systems)"*[106]

The report on acoustic environment presented by the proponent on July 2015 [T13] provided then a partial integration of such requirements, integrating only the climatization system, while in September 2015, after the Environment Area response that restated the same requirements [T14], a new report [T15] integrated the mechanical ventilation system (see Figure 6.12). The same report, however, also contested the request of mitigation solutions on the façade, reporting the opinion expressed by the architects who were in charge of the project.

More specifically, the use of sound absorbing plaster is contested as "*the part of façade towards the avenue that is cladded with plaster is of scarcely significant size and it is considered that, seen the impossibility to profoundly modify the façade design[…] it would not generate significant effects on the reduction of the reflections of car noises coming from the avenue"*[107].

While, as far as modifications of the façade design are concerned, the report stated that*:*

[106] Response from the local Environment Area, 31st July 2015. In the original: "[…]- *di prevedere l'utilizzo di intonaci e materiali fonoassorbenti in facciata al fine di minimizzare gli effetti dovuti alla futura riflessione; - di rivalutare la tipologia di facciata, prevedendo una doppia pelle a protezione degli ambienti di vita. Al fine di superare di fatto eventuali problematiche relative a superamenti residui non esclusi dal tecnico competente in materia di acustica ambientale, - di definire le dotazioni impiantistiche previste, anche in ragione delle prestazioni energetiche, al fine di massimizzare il comfort interno (VMC e sistemi di climatizzasione/raffrescamento".*

[107] Integration to noise climate report, 1st September 2015. In the original: *"sul corso stesso la superficie trattata ad intonaco della facciata risulta di dimensioni poco significative" e "si ritiene quindi che, alla luce dell'impossibilità di stravolgere l'architettura dell'edificio in progetto, che […] non produca effetti significativi sulla riduzione della componente riflessa del rumore emesso dal traffico veicolare lungo corso Moncalieri."*

“the <<façade typology>> is a complex architecture that required long detailed studies in relation to the area, which is located in an environmentally protected area, according to the national law DLgs 42/2004, and to the Regional Law 32/2008, and within the perimeter of protected hilly area in the local General Masterplan of the city of Turin.

The above-mentioned laws delegate the authorization of building works within those areas to the Piedmont region, […] that issues a definitive, binding response.

[…] In the resolution n.38, of the 10^{th} February 2015[…] the region[…] authorized the realization of the designed buildings […] justifying the approval […] with the “randomized” location of verandas in aluminium and wooden elements, which “deconstruct” the volume of the building towards corso Moncalieri*[…] that are almost independent from the plans of the flats”* [108]

The legislative decree 42/2004 (Code of Cultural Heritage and Landscape)[109] assigns indeed to the State and the regions the administrative functions with respect to protection of landscape and regulates the granting of landscape authorization to urban transformations (art. 146).

According to the Piedmont Regional Landscape Plan, compiled according to the decree 42/2004, the area is within a landscape protection zone, and the transformation is therefore subject to the granting of a landscape authorization from the Piedmont region, since it includes a quantity of Gross Floor Area above 3000 m^2 (see art. 3 LR 32/2008)[110].

With the determination n. 38/2015, the regional landscape commission had therefore approved the project, reporting that *“[the buildings[are characterized by the presence of protruding and sunken parts[…] and from sun screens in wood and aluminium, that, besides reducing the visual impact of the glazed elements, create an effect of vertical rhythm”.*

The design of the facades was therefore quite locked already before the granting of the building permit for allotment 1, although small modifications may have been realized.

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[108] Integration to noise climate report, 1st September 2015. In the original: *“la “tipologia di facciata” è un’architettura complessa che ha richiesto lunghi approfondimenti progettuali correlati alla localizzazione dei fabbricati, ricompresi in Area Ambientale protetta e tutelata ai sensi del Decreto Legislativo 22 Gennaio 2004, n. 42 – Parte III Legge Regionale 1 Dicembre 2008 n. 32 e dal perimetro di tutela delle aree collinari e prossime ai fiumi dello stesso PRG della Città di Torino.*
Le leggi sopracitate delegano la competenza autorizzativa per gli interventi edilizi negli Ambiti di cui sopra alla Regione Piemonte – Direzione Ambiente, Governo e Tutela del territorio e alla Soprintendenza Architettonica che esprime parere vincolante definitivo
[…] la Determinazione Dirigenziale n, 38 del 10 febbraio 2015, della Direzione Ambiente, Governo e Tutela del territorio della Regione Piemonte […] autorizza la realizzazione degli edifici in progetto […] motivandone, nella relazione allegata, l’approvazione stessa, con evidenziazione degli elementi architettonici e materici che ne costituiscono vincolo: l’articolazione anche “randomizzata” delle serre/verande in alluminio ed elementi lignei, atta a “decostruire” il volume edificato sul Corso Moncalieri […] quasi indifferenti alla configurazione planimetrica delle unità abitative[…]”

[109] Decreto Legislativo 22 gennaio 2004, n. 42 ”Codice dei beni culturali e del paesaggio, ai sensi dell’articolo 10 della legge 6 luglio 2002, n. 137”

[110]Legge regionale 1 dicembre 2008, n. 32. “Provvedimenti urgenti di adeguamento al decreto legislativo 22 gennaio 2004, n. 42 (Codice dei beni culturali e del paesaggio, ai sensi dell'articolo 10 della legge 6 luglio 2002, n. 137)”

As further clarified in an interview with the Private Building Area of the city of Turin[111]: *"Due to the Gross Floor Area of the project, the landscape authorization had to be granted by the Region, instead of the local landscape commission. This is done after the* PEC *approval, when the realization of the area has to start. In this case, the* PEC *was divided into five building permits. When the first building permit, for the underground parking, was requested, all the documents related to the* PEC *were sent to the Region to have this authorization. […] the proponents were worried that modifications to the facades may require to come back to the Region approval again. However, small modifications may have been done by requiring the response only to the local landscape commission".*

The necessity to keep the potential modifications limited contrasted however of course with the realization of a double skin, which, as stated moreover by the architects "*is basically unapplied and hardly applicable on residential buildings, as demonstrated by the absence of similar project, as well as of dedicated products on the market and the incongruence with the use of the openable windows of a living environment: natural ventilation (with easy openings), natural light, windows cleaning and maintenance"*[112]

The proponent further expanded their point of view during an interview[113], underlining how the double-skin façade would have posed serious complication with respect to natural ventilation requirements, as well as fire-safety norms, since a double-skin façade could impede the access through stair lifts:

"*If i have a double skin between the stair lift and the building, how do I get to the building?[…] so all the buildings, even below 24 m normative limit, should have fire safety facilities in this case […] so fire-cutting doors, and so on […] is not a small issue".*

Finally the same report of September 2015 questioned the requirement of remodulation in the distribution of indoor environments, in order to have sleeping rooms on the quiet side, as the layout of the buildings *"may vary during the selling phase, with sleeping rooms becoming living rooms, and vice versa, by widening or shrinking the flat typologies of the project, also in relation to the difficulties of the housing market, in which flexibility of plans is fundamental"*[114]

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[111] Interview conducted on 22nd February 2019

[112] Integration to noise climate report, 1st September 2015. In the original: *"é praticamente inapplicata e poco applicabile sugli edifici residenziali, come dimostra l'assenza di progetti in tal senso, l'inesistenza di prodotti dedicati, l'incongruenza con le fruizioni/utilizzazioni delle aperture in una camera: areazione/ventilazione diretta (con facilità di apertura), illuminazione, pulizia delle vetrate, durata e manutenzione degli infissi".*

[113] Interview conducted on 3rd March 2018

[114] In the original: *"potrebbe essere variato in fase di vendita, con camere da letto che diventano soggiorni e viceversa, in ampliamento o compressione delle tipologie presenti nel progetto, anche in relazione ad una grande difficoltà del mercato immobiliare, ove la flessibilità delle piante è fondamentale*".

The controversy, temporarily suspended with the granting of building permit for allotment 1, in which mitigation at source were evaluated as sufficient for that allotment (see Subsection 6.4.1), was opened again for the request of the building permit for allotment 2. When the acoustic environment report for the new building permit request was issued in November 2016, the response of the Environment Area, on 23rd December 2016 [T18], while verifying that in the acoustic environment report were not included the mitigation measures assigned to that allotment, estimated as 3/3.5 dB reduction, re-proposed an "appropriate design of opaque and transparent façade elements" as a way to provide such reduction[115]. Requirements that was then restated in the following response, in April 2017 [T20] (see Subsection 6.4.2).

The report provided by the proponent in October 2017 [T22] integrated then the requests of the Environment Area, only with respect to the re-modulation of the floor plans for the part of the building related to allotment 2 facing *corso Moncalieri* (as a matter of fact, due to the limited amount of flats of allotment 2 facing the avenue, only 3 rooms were modified).

The modification of the floors layout, although requested, were however not useful to respond to the need of verifying the noise limits on the facades facing the avenue, regardless of the environment which are behind them (as required by the local noise policies and restated by the regional environment agency *ARPA*). The same report proposed therefore the use of a screen inside the verandas, placed in order to shade the windows from direct noise and reach the desired levels in front of such windows. While keeping the facades design unchanged. As reported by the acoustic consultant, the screen derived from the need to find a solution that would satisfy the requirements of noise mitigation (being "*acoustically saleable")* while keeping the façade design unchanged[116].

The response of the Environment Area on 11th January 2018 [T23] indicated how this last proposal looked "critical in terms of use of the spaces". Nevertheless, the investigation of possible mitigation solutions involving the building façade would then lead to a change in the request of the Environment Area, that would finally lead to the unlock of the process, after some additional controversies, as will be shown in Section 6.5.

Figure 6.11 shows the debate on balconies and façade design through a network visualization derived from Atlas.ti software analysis. As for Figure 6.9, the *matter of* concern is reported in the red label on the left side of the map, and the actions (grey labels) are linked to it. Each actions then connected to all the actors involved in it. By looking at human actors (blue labels) it can be seen that the Environment area is mainly linked to the proposal of the different solutions, while the proponent, architect and acoustic consultant discuss the limitation to them. The map also

[115] Response of the local Environment Area, 23rd December 2016

[116] Interview conducted in August 2017

visualized the non-human actors involved in the *matter of concern*, already explained in the present subsection. In particular, it can be seen how the opposition to the different mitigation solutions that involve balcony and façade design is connected to specific characteristics of the building design (beige labels) such as plastered areas and façade design, to requirements posed by other law such as the ventilation requirements of the DM 5/7/1975 and the fire safety requirements of the DPT 151/2001 (light green labels). Moreover, the façade design is also limited by the regional landscape authorization to the project, already issued (pink label), which in turn was due to other normative requirements (light green labels) due to the environmental quality of the area in which the specific project is located (greenish label).

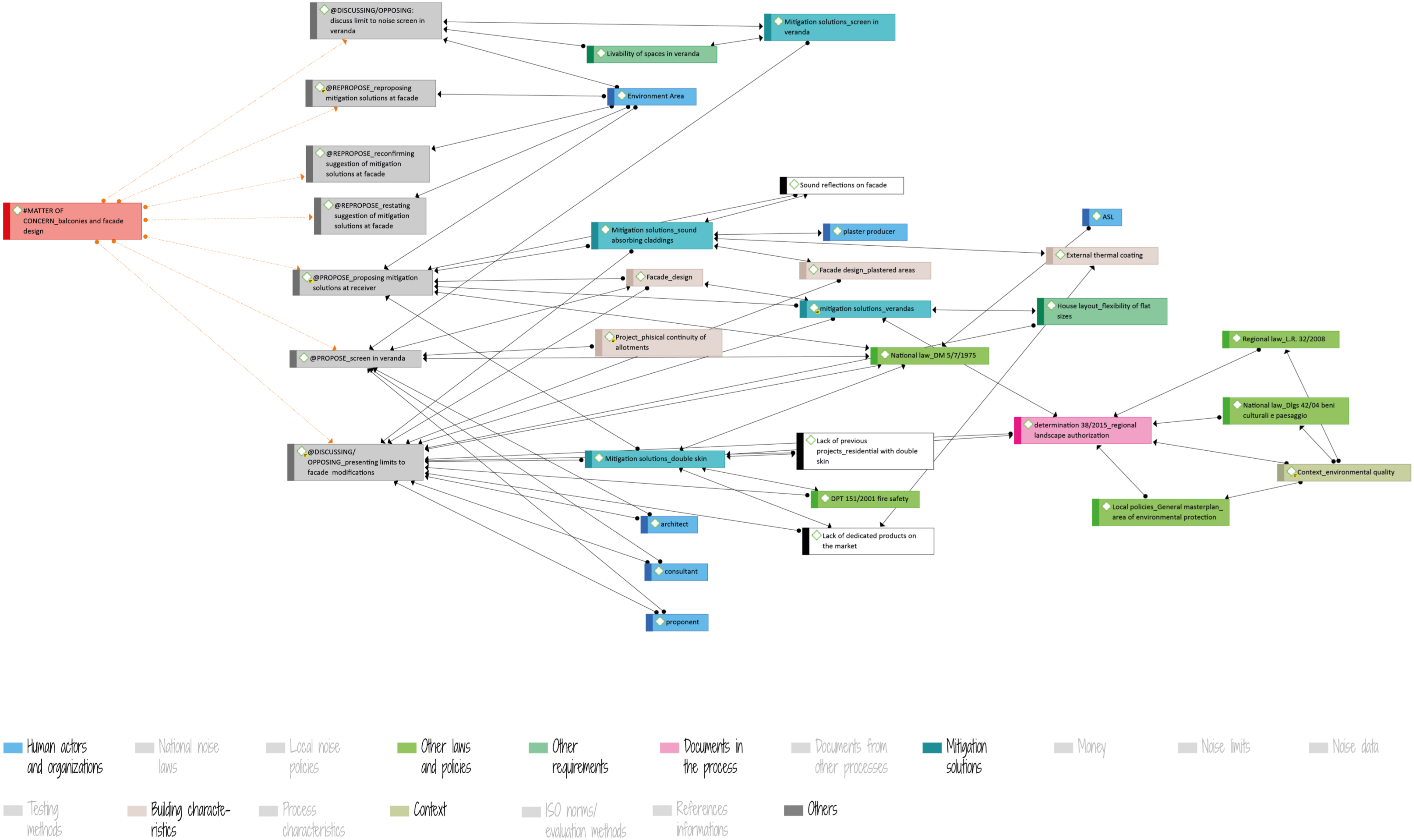

Figure 6.11 – *Matter of concern* of balconies and façade design with related actions and actors involved in them

Figure 6.12 shows the map related to the zoom on the two *matters of concern* on mitigation solutions at receiver emerged during the process, namely "balconies and façade design" and "systems and indoor design", using again the "concern" map illustrated in Subsection 4.3.2.

Below each of the two grey bars representing the development in time of the *matters of concern* are listed, as in Figure 6.10, all the solutions that were considered during the process with respect to the specific issue. By focusing on the concern of balconies and façade design, it can be seen how five different solutions were proposed in the process. However, as already detailed in this subsection, a successful *translation* could not be reached for any of the mitigation solutions which involve the design of balconies, facades or verandas (no green ticks). By looking at the kind of non-human actors influencing such failed translations, it can be seen how only in the case of double skin façade (second line in the list of solutions) the rejection involved actors that are not related to the contingency of the specific process and project, and are likely to pose issues on every project, such as the natural ventilation requirements of the DM 5/7/1975 and the fire safety requirements posed by the DPT 151/2001 (light green column in the "non-human actors table on the right side of the map), or the lack of dedicated products on the market (grey column). On the other hand, the rejection of sound absorbing cladding and remodulation of design of the verandas is linked to actors which are due to the specificity of the investigated project, and in particular to the late tackling of the issue of mitigation solution at facade. In particular, the rejection is due to specificities of the building design (beige column) such as plastered area or design of verandas, that were already fixed at the time in which the mitigation solutions were proposed. Similarly, the context where the project is located (greenish column) and the legislative requirements of DLgs 42/04 and of LR 32/2008 (light green column) determine the rejection of the proposed solutions only because they determined the regional landscape authorization (pink column) that limited further modification to the façade.

On the other hand, it can be seen how this *matter of concern* involved a smaller network of human actors and organizations ("human actors" section in the map). From the observation of the map, it can therefore be assumed that **noise mitigation at receiver, involving the design of the building,** could be a good solution as they can simplify the process as **may not require extra time for their realization and agreement with other parties,** since are integrated in the building design and realization. Of course, **this requires to tackle the issue at the very first design stages**.

Finally, by focusing on the "systems and indoor design" *matter of concern,* it can be seen that the mitigation solutions which involved equipment and indoor design could instead be implemented also in further stages of the process, since they did not have a great effect on the design of the building (green ticks on all the three solutions proposed during the process, namely air conditioning, mechanical ventilation and sleeping rooms on quiet side). However, the integration of the solution in this case did not correspond to the closure of the controversy and the moving forward of the process, due to the fact that, although such solutions were suggested and recognized as an improvement by the Environment Area, their usefulness was limited by the fact that they did not answer to the need of keeping the noise levels low on all the facades, including the one facing the street, no matter what living environment is behind it, as required by the local Acoustic Classification plan.

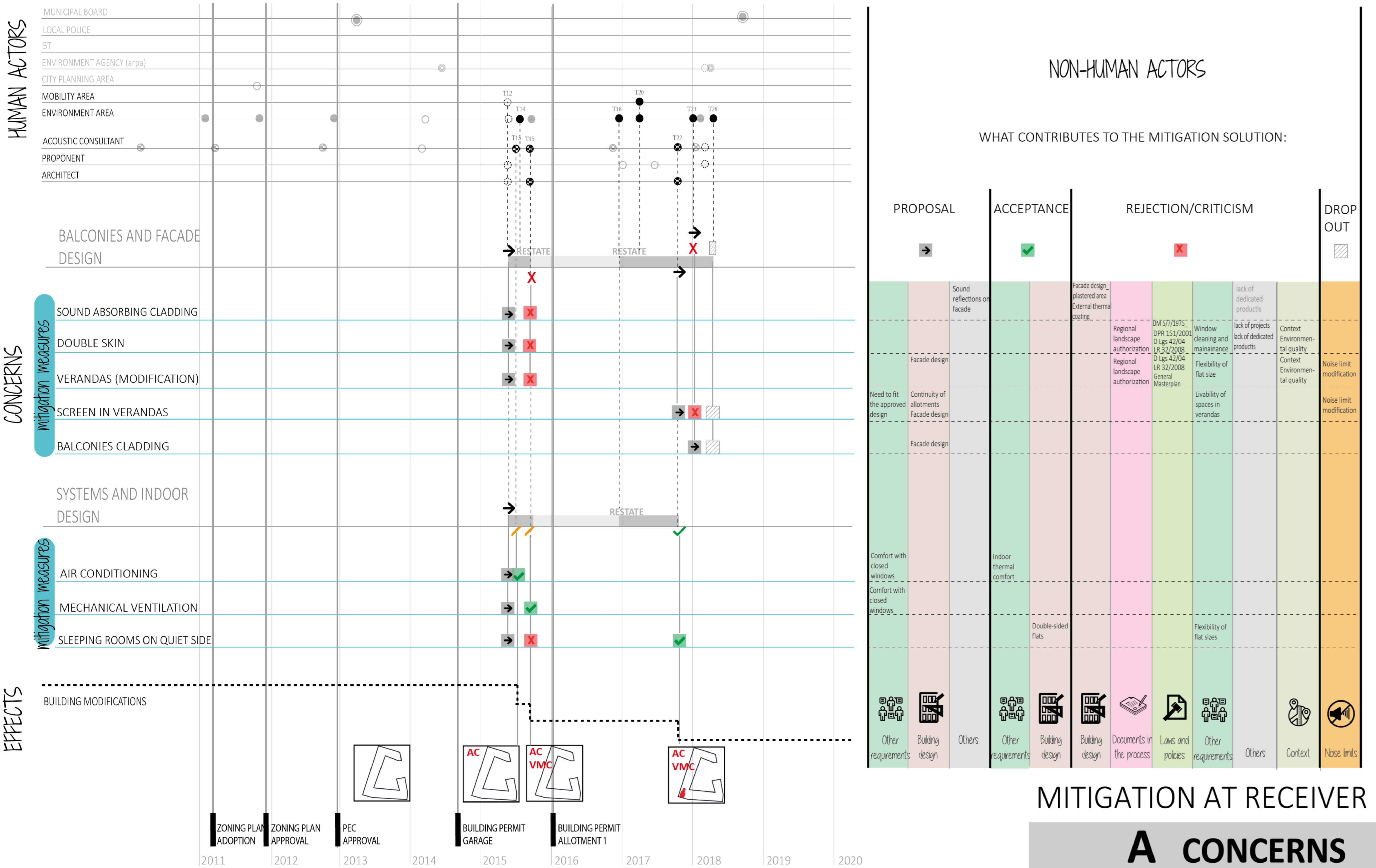

Figure 6.12– "concern" map related the matters of concern of mitigation solutions at receiver

6.5 The setting of new limits

6.5.1 A new limit deriving from another transformation process

As seen in the previous section, the response issued by the Environment Area on 11th January 2018 [T23], in reply to the report of October 2017 [T22], set a rather important turning point in the process. After providing an evaluation of the proposed solutions and restating the limits of 60 dB(A) at side road and 55 dB(A) at façade, the response reported:

"By analogy with previous evaluations done with the support of ARPA *and* ASL *on November 2017, in order to favour solutions that minimize the level of street noise inside living environments, while still ensuring the needed levels of natural ventilation […] we propose therefore to adopt a measurement set inside the room with open windows, as index of living quality, even in case of presence of mechanical ventilation. To this purpose, we request to verify the achievement of noise mitigation goals through measurements at façade, following the indication of DM 16th March 1998, or through a measurements in the centre of the room, with open windows, at an height of 1,5 m from the floor. In this second case, it will have to be verified that the indoor levels do not exceed the façade limits, with a reduction of 5dB, by analogy with situations with no particular protections on the facade"*[117]

The Environment Area, *ARPA* and *ASL* proposed therefore a new shared interpretation of the norm, in which the measurement prescriptions given by the law are interpreted in order to get a condition that can still grant the environmental comfort that is at the basis of the requested limits.

The "previous evaluations" referred to in the response derived from the decisions reported in the concluding report of the technical panel held on the 20th November 2017, carried out to discuss the case of another transformation area in Turin, the *ZUT "8.7 Pronda"*.

This transformation area, of about 72800 m^2, is situated on the western boundary of the municipality of Turin (see Figure 6.17a). Already indicated as "*Ambito 8.7 Pronda"* in the General Masterplan of the city, with a mainly residential destination, the area had been divided into 5 sub-areas with the

[117] In the original: *"In analogia con valutazioni già condotte con il supporto di ARPA ed ASL nel novembre 2017, dovendo privilegiare soluzioni realizzative che minimizzino l'immissione del rumore stradale all'interno degli ambienti, pur garantendo i necessari livelli di ventilazione e ricambi d'aria […] si propone quindi di assumere una condizione di misura a finestra aperta come indice della qualità abitativa degli ambienti, pur in presenza di aerazioni controllate, e a tal fine si richiede di verificare il raggiungimento degli obiettivi di risanamento o tramite una misura in facciata, secondo le modalità previste dal DM 16 marzo 1998, oppure tramite una valutazione al centro stanza, a finestre aperte, all'altezza di 1,5 metri dal pavimento.*
In tal caso, si dovrà verificare che i livelli interni non eccedano i limiti previsti in facciata, a meno di una riduzione di 5 dB, in analogia con situazioni di assenza di protezioni speciali a livello di facciata".

Masterplan structural variation n.38, in April 2006, in order to facilitate its execution.[118]

Given the difficult realization, due to the highly fragmented land property included in the *ZUT*, on December 2020 a request of a new zoning plan, in variation of the General Masterplan, had been presented by some of the land owners, proposing to modify the perimeters of some of the sub-areas, in order to make them coincide with the different properties of the owners who wanted to realize the previsions of the plan (see Figure 6.13b).

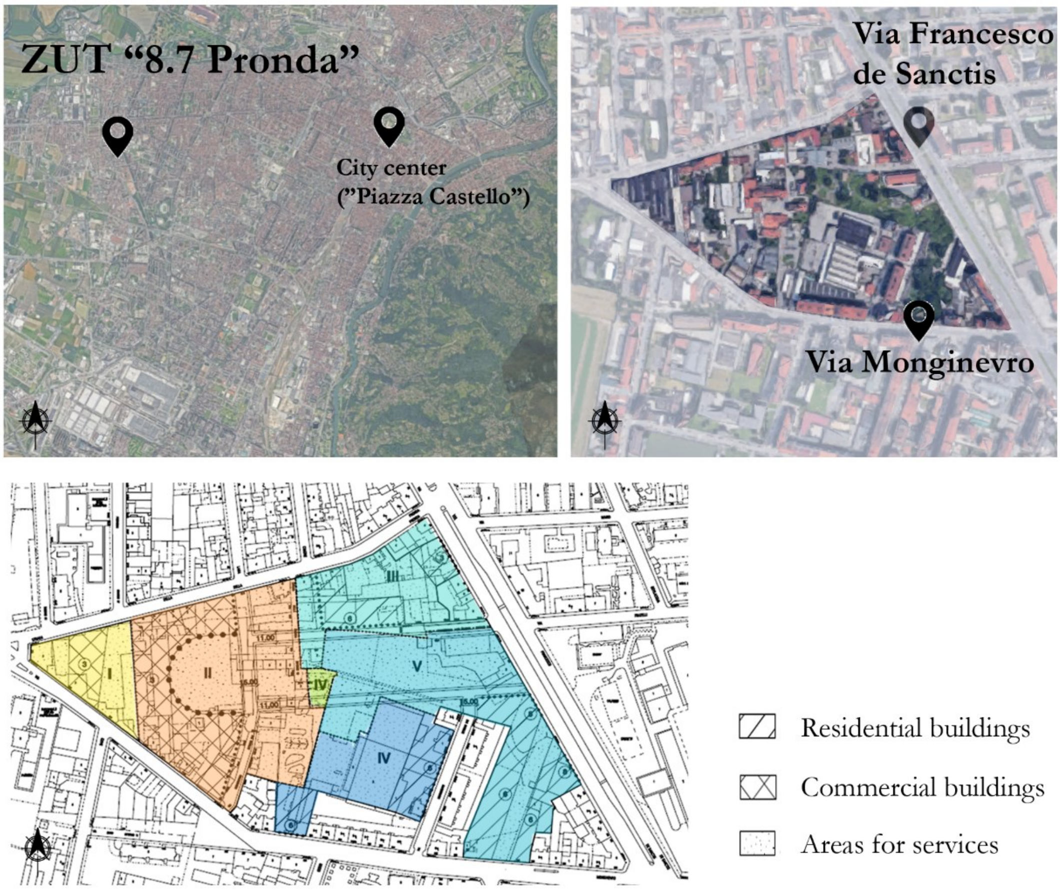

Figure 6.13 – Location of the *ZUT "8.7 Pronda"* with respect to the city of Turin; perimeter of the *ZUT* and indication of the noise sources; division of the *ZUT* into sub-areas (coloured areas), with indications of the concentrations of buildings and services areas (elaboration of the author on the basis of the Explanatory Memorandum of the zoning plan)

The Masterplan variation 247 had therefore been adopted on the 5th December 2011 and approved on the 26th March 2012[119], with a design proposal that verified the compatibility of the built areas distribution with the redefinition of the perimeters of the sub-areas and that proposed a series of buildings facing a central square and situated along a new public pedestrian path (see Figure 6.13b).

[118] Città di Torino, "Piano Regolatore Generale di Torino. Norme Urbanistico Edilizie di Attuazione. Testo coordinato al 31/07/2014", art. 7

[119] Città di Torino, "Piano Regolatore Generale di Torino. Norme Urbanistico Edilizie di Attuazione. Testo coordinato al 31/07/2014"

In September 2014, the same owners that presented the zoning plan proposal presented then a project for the sub-area V, which was considerably expanded by the Masterplan variation, in turn subdivided into two sectors, as well as a *PEC* proposal for sector 1.

The proposal involved the realization, consistently with what established in the new zoning plan, of a large green area in the northern part of the sector, to be given to the city as a part of the central square foreseen as a centre of the *ZUT*. The buildings were therefore supposed to be concentrated in the southern part of the sector, towards the main roads surrounding the area (see Figure 6.14).

The evaluation of acoustic environment presented with the *PEC* proposal, following the requirements of the local noise regulation (see Chapter 5), put however in light a high exceedance of the noise limits at night time for the most part of the buildings in the project, in particular for those facing the main road, on the east side of the area (see Figure 6.14).

During the verification of eligibility of the *PEC* for Strategic Environment Assessment (see Section 5.3), started on the 29th September 2015, *ARPA* had therefore requested a redesign of the *PEC* proposal, with a relocation of the buildings as far as possible from the main roads, given the high noise levels in their proximity. It also specified that only afterwards, in case of remaining criticalities, would be inserted some mitigation measures at source, such as the use of a sound absorbing asphalt and the reduction of vehicles speed.

As an answer to such request, the proponents modified the distribution of built volumes in the area, and presented a new proposal in July 2017, together with a new acoustic environment evaluation (See Figure 6.14). The report indicated noise levels below the requested limits for the evaluated facades, although it only considered the sleeping room facades, since it had been given attention to their disposition towards the less-exposed sides, as requested.

Figure 6.14- Buildings distribution in the Executive Planning Instrument for the transformation area "8.7 Pronda", 2015 proposal and 2017 proposal. The colours indicate the different distributions of public green areas, roads, buildings (purple), private areas (pink) and private areas subjected to public use (yellow)

However, in the living rooms facades, presented in the report integration on the 10th November 2017, exceedance of the noise limits could still be found for the buildings facing the southern road.

The new design proposal was therefore evaluated by the technical panel composed by the Environment Area, *ARPA* and the health authority *ASL*. During the panel *ARPA* pointed out how *"noise protection cannot ignore the freedom in the use of indoor spaces, according to owners' preferences [...]. Distribution of indoor spaces, in particular for ZUT, cannot therefore be the strategy to avoid outdoor noise mitigation"*[120]

The use of façade designs and elements as mitigation measures, however, was still debated, as ASL *"underlines the non-feasibility of solutions such as the double skin, where it does not guarantee, for residential use, the necessary natural light and ventilation (in particular the direct ventilation of the rooms)*"[121]

The Environment Area had however stated the importance *of "assuming shared evaluation criteria for the evaluation of acoustic compatibility of the projects in the case of the transformation areas"*[122], since in those areas the mitigations measures have to be realized and verified by the proponents, and not by the local administration.

The three bodies then shared the need, in particular for cases in which the transformation is bound to the location of buildings along the street edge, to identify *"solutions that minimize the incoming noise inside living environments, while still guaranteeing the needed ventilation, hence valorising the adoption of appropriate design solutions for facades and indoor environments, which can reduce the indoor noise levels due to the infrastructure"*[123]

Aa a conclusion, it was therefore proposed to adopt a noise level verification through indoor measurements, to be conducted at the centre of the room, with open windows. The results of such measurements had to not exceed the limits set for the levels at the building façade, decreased by 5 dB (i.e. 50 dB(A)). This solution is therefore set to be applied in the future transformation of the ZUT 8.7 Pronda.

The quantification of the expected difference between noise levels at the façade and indoor levels with open windows comes from previous literature (Ryan, Lanchester, and Pugh 2011), as well as from previous experiences of ARPA, as the agency itself clarified in April 2018.

Also in this case, there are no references or guidelines to draw upon. Since the few data that could be found in literature report a range of differences of 5 to15 dB between measurements at the façade and indoor with open windows (Ryan, Lanchester, and Pugh 2011), it has been decided for the less-restrictive limit, *"by*

[120] In original: *"la protezione del rumore non possa non considerare la libertà di usufruire dei locali a proprio piacimento[...]. Soluzioni distributive, in particolare per gli ambiti di attuazione, non possono pertanto essere la strategia per non affrontare il risanamento acustico in ambiente esterno".*

[121] In original: "evidenzia la non percorribilità di soluzioni tipo "doppia pelle" laddove non garantisca, per gli usi residenziali, i necessari rapporti aeroilluminanti (in particolare la ventilazione diretta degli ambienti"

[122] In the original: *"assumere criteri condivisi di valutazione della compatibilità acustica delle trasformazioni nei casi di attuazione di Aree di Trasformazione (ZUT e ATS)":*

[123] in the original: *"soluzioni realizzative che minimizzino l'immissione del rumore stradale all'interno degli ambienti, pur garantendo i necessari livelli di ventilazione e ricambi d'aria", valorizzando quindi l'adozione di opportune soluzioni di disegno della facciata o degli ambienti interni che riducano i livelli di rumore interni dovuti alle infrastrutture.*

analogy with situations with no particular protections on the facade"[124], estimating a 5 dB reduction[125].

As indicated by the Environment Area, the range of reduction reported by the considered literature would have allowed also to request a higher reduction, setting 45 dB(A) limit for indoor measurements, so to get closer to the 40 dB(A) set by the national law (DPR 142/04, see Subsection 5.1.3), which is the only available normative reference, and to pose a limit in line with the World Health Organization indications (see Subsection 1.1.2). However, also other requirements had to be taken into account, as

"A too strict request, like a 10 dB reduction, could lead us to the risk to lose all the local acoustic policy on ZUT, as it would be perceived as a resolution that hinders urban transformations, with obvious economic impacts due to infrastructure charges, jobs in the construction sites, and so on.." [126]

Figure 6.15 shows a focus on the set of 50 dB(A) limit for the *ZUT 8.7* "Pronda", showing the network of actors derived from the tags extracted in Atlas.ti (see Chapter 4). The maps proposes a visual synthesis of what said in this Subsection, showing the network of actors that are "embedded" within the new 50 dB(A) limit. In the map, it can be seen how the three authorities taking part to the decision (*ARPA, ASL* and Environment area, blue labels) have been influenced in the decision by other requirements (green labels), the data deriving from previous literature (yellow label) and the will to promote the benefits of certain mitigation solutions at façade. The national laws (violet label) contributed by providing a reference for indoor environment measurements, while the local policies (purple label, by setting specific requirements for transformation areas, pushed for the need to find common direction to promote and evaluate noise mitigation solutions in such areas.

In this case, the limits posed by the national and local policies with respect to noise mitigation, "clashing" against the contingency of the real process and with the different norms and requirements to which it has to respond, are reformulated and "translated" into different measurement point and reference levels. Such modification will then be reported outside the specific process in which it was created and used in other processes, creating a new praxis in the application of noise mitigation policies in the city of Turin (as a matter of fact, a sort of "extension" of the part of the norm that regulates the *ZUT*s). This clearly **shows the "recursive/relational" relationship between norm and project** (see Chapter 2) in action, in which a "leader city" **develops its own policy (or the modalities for its application), appealing to practical experience and previous literature**, and integrating it with the goals of the national norm.

[124] Technical panel report, 20th November 2017

[125] Interview with teram manager of the Environment Area, conducted on 25th January 2018

[126] *Idem*

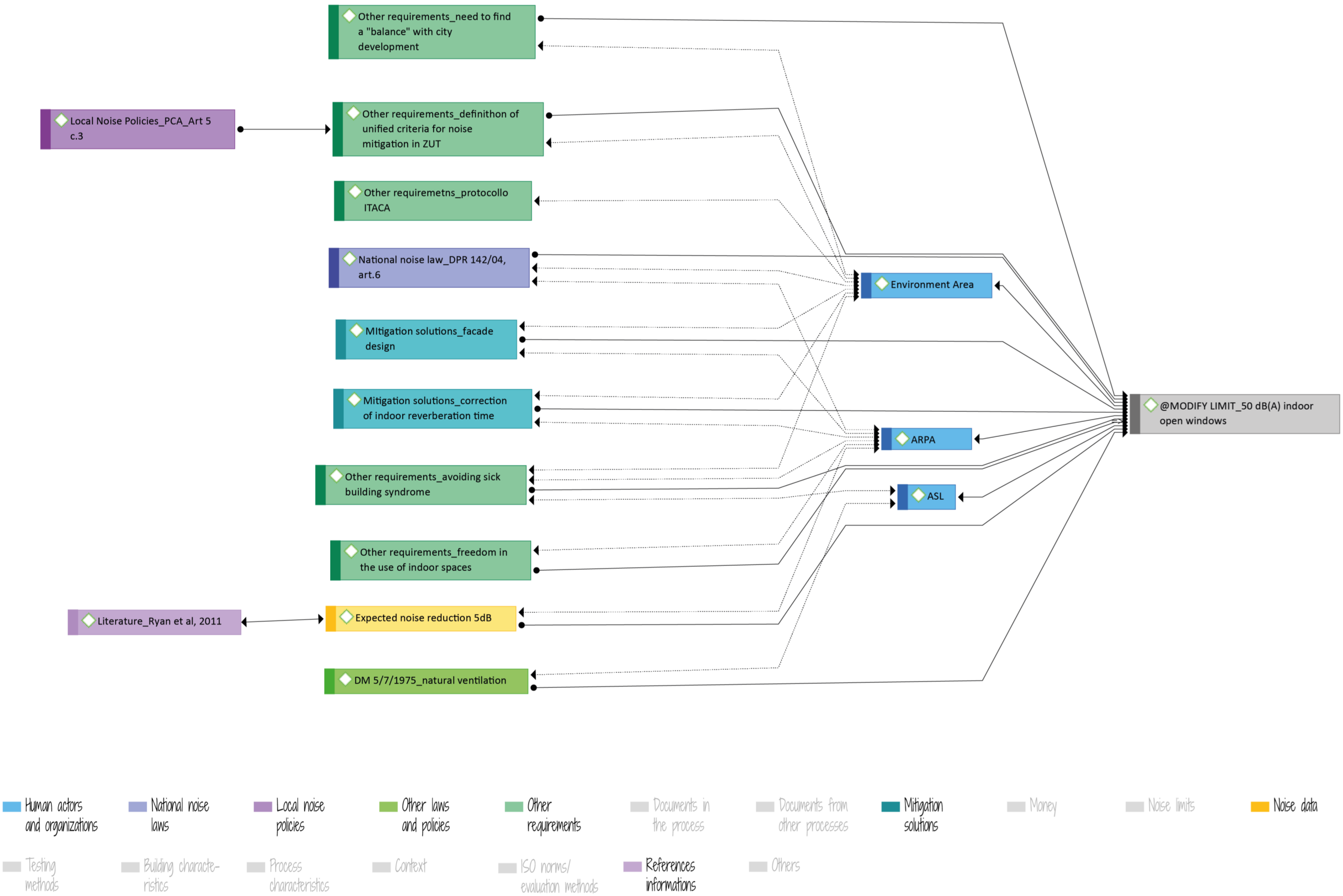

Figure 6.15 - Network of actors involved in the establishment of the new limit of 50 dB(A) for indoor measurements with open windows

The same solution has then been used, as seen before, as a possible alternative for the *ZUT 13.11 Moncalieri*[127].

Figure 6.16 goes back to the process of *ZUT* "13.11 Moncalieri", using again the "concern" maps to zoom on the *matter of concern* related to noise limits and their verification modalities.

The two *matters of concern* comprised in this map are the "noise limit" concern and the "testing methods" concern.

As can be seen from the map, the concern on noise level to be considered as limit was opened by the first Environment area response [T2] that set the 60 dB(A) at side road (first of the 5 limits listed below the grey bar of the "noise limits" concern). The setting of such limit, not reported in any norm, was due to a number of factors, as already reported in Section 6.3. Indeed, the overlapping of the zoning plan with the entering into force of the Acoustic Classification plan (brown column in the "non-human actors table on the right side of Figure 6.16), as pointed out by the local Environment Area, leaded to the decision of applying for the first time the requirements of the Acoustic Classification plan for the transformation area (purple column), binding its realization to a target noise limit value. However, since the evaluations needed to be done before the completion of the building, a control receiver on the side of the road was used as a reference to evaluate noise reduction (red column). Measurements at this receiver resulted in a 70 dB(A) level for night time (yellow column). Since the evaluation done through acoustic software on a draft version of the building presented for the zoning plan (red column) resulted in a 5 dB reduction from side road to façade (yellow column), maybe also due to the vertical greenery foreseen in the project (beige column), it was decided to request a target level of 60 dB(A) at side road, to be verified before the completion of the project.

The concern was then complicated by the second response from the Environment Area [T5] that, in order to answer to a clarification request [T4] specified that the 60 dB(A) at side road was aimed at obtaining the 55 dB(A) limit at facade, posed by the Acoustic Classification plan. This response leaded *de facto* to the setting of a double limit (60 dB(A) at side road and 55 dB(A) at building façade), which were then both referred to in the following documents [T11-T14-T16].

Such values, initially supposed to be equal (as a 5 dB difference was expected between side road and building façade), through the process resulted to be different requirements. Indeed, the alignment of the buildings to the road edge, in the *PEC* design, leaded the two measuring points (façade and side road) to almost overlap. Given this situation, such requirements were repeatedly contested by the proponent [T13-T17], that firstly proposed to use as a reference the 40 dB(A) indoor level with closed window (fourth solution listed in the map), allowed by the national law DPR

[127] According to the proponent, the transposition of the decision from one process to the other was facilitated by the fact that both the projects were promoted by the same proponent (interview conducted on March 2018)

142/04 (violet column) in particularly difficult cases (see Subsection 5.1.3). Moreover, given the uncertain situation posed by the double limits, together with the fact that the 60 dB(A) limit requirement had been reported in the zoning plan rules (pink column), they also proposed, as a mid-way solution, to consider the 60 dB(A) at façade as unique limit (fifth solution listed in the map).

The *matter of concern* was however closed when the new limit of 50 dB(A) to be measured indoor with open windows (third solution listed in the map) was established by the Environment Area response in January 2018 [T23], as already pointed out at the beginning of this subsection. As seen before, this derives from the technical table held for the "Pronda" transformation area (light pink column in the "non-human actors" table, "documents in other processes"), and was established on the basis of the 55 dB limit set by the Acoustic Classification plan (purple column) and of an expected noise difference of 5 dB from indoor to outdoor level (yellow column) derived from previous literature (lilac column), on the basis of the need to also balance with other laws and requirements (Light green column and dark green column). The measuring position was derived from national noise laws (violet column).

The new measuring point for the verification of noise limits, while closing the *matter of concern* on noise limits, leaded to the opening of a new *matter of concern*, as it posed problems related to the verification modalities of such limits. A series of devices put in place by the developer and the acoustic consultant, as well as the checking of the result from *ARPA*, managed however to solve the problem, as will be shown more in depth in Subsection 6.5.2.

The acoustic environment report of October 2017 [T22], while proposing the mitigation solution of the screens located inside the veranda (as seen in Subsection 6.4.3), reported the results of an evaluation done through a simulation software for outdoor environments, which, as designed for noise calculation of quite wide outdoor areas, does not allow for a detailed modelling of the building façade, although allowing for the calculation of multiple sound reflections.

The report itself indicated that: *"The graphic interface of the software that has been used does not allow for a detailed definition of the real situation to be simulated: in particular, it is not possible to draw the projecting balconies on which the verandas and the indoor screens are located."*[128]

The response of the Environment Area of the 11th January 2018 [T23], after suggesting the limit of 50 dB(A) to be measured indoor with open windows, requested therefore the use of an acoustic simulation software designed for indoor environments, as they allow for a more detailed modelling. The software for indoor

[128] In the original: *"L'interfaccia grafica del software utilizzato non permette una definizione particolareggiata della reale situazione da simulare: in particolare non è possibile disegnare il balcone in aggetto dell'edificio sul quale è prevista la veranda e lo schermo ad essa interno. Per riprodurre, quindi, una situazione assimilabile a quella reale sono state realizzate le vetrate della veranda come schermi verticali fissati al piano strada. In questo modo si presume una riduzione dell'effetto di abbattimento acustico, in quanto viene a mancare la schermatura del balcone in aggetto"*

environment is listed as first of the proposed solutions in the map in Figure 6.16. It can be seen that its proposal is due to the complex design of balconies and verandas of the building (beige column) in the "non-human actors" table, together with the model detail that the software can provide (red column).

However, the acoustic consultant rejected such proposal (red X on the line corresponding to "software for indoor environments" solution), due to the cost of the software and of the need to hire an expert user in order to handle it (light blue column in the "non-human actors" table, under the "rejection/criticism" part.

The Acoustic environment report of January 2018 [T24] proposed then two other verification modalities, in order to verify the indoor limit for apartments with different façade design in the foreseen building, namely in-field measurements conducted in a test environment and in an adjacent building (second and third solution listed in the map in Figure 6.16). Such proposals were made possible by the fact that a test environment had been realized in the building site for showing to possible buyers (brown column in the "non-human actors" table), while the adjacent building had a similar façade design with respect to the building in the project (greenish column). The report by the acoustic consultant already provided the data of the results of such measurements. The results were however checked by the Environment agency (ARPA) through the repetition of the same measurements [T26]. Results reported in the ARPA report of April 2018 [T27] showed results compatible with the ones provided by the acoustic consultant. Therefore, the two proposed in-field measurements methods were accepted by the Environment area on 23rd April 2018 [T28] thanks to the ARPA technical advice (pink column in the "non-human actors" table, under the "acceptance" part) and the *matter of concern* was closed.

In this case, therefore, **the establishment of a new measuring point to verify the noise levels implied also the "crafting" of new testing modalities**. The labels I and II on the map in Figure 6.16 indicate two zooms on the measurements provided by the proponent and on the verification of measurements from *ARPA*, respectively. The zooms will be expanded in Subsection 6.5.2, showing the complex network of actors that made them possible.

The results obtained from such verification measurements, showing a higher difference between indoor and outdoor noise levels with respect to the 5 dB indicated by the Environment area, made further mitigation measure, a pat from the ones already envisioned, unnecessary, hence closing the *matter of concern* on mitigation solutions at the façade, as seen in Figure 6.12.

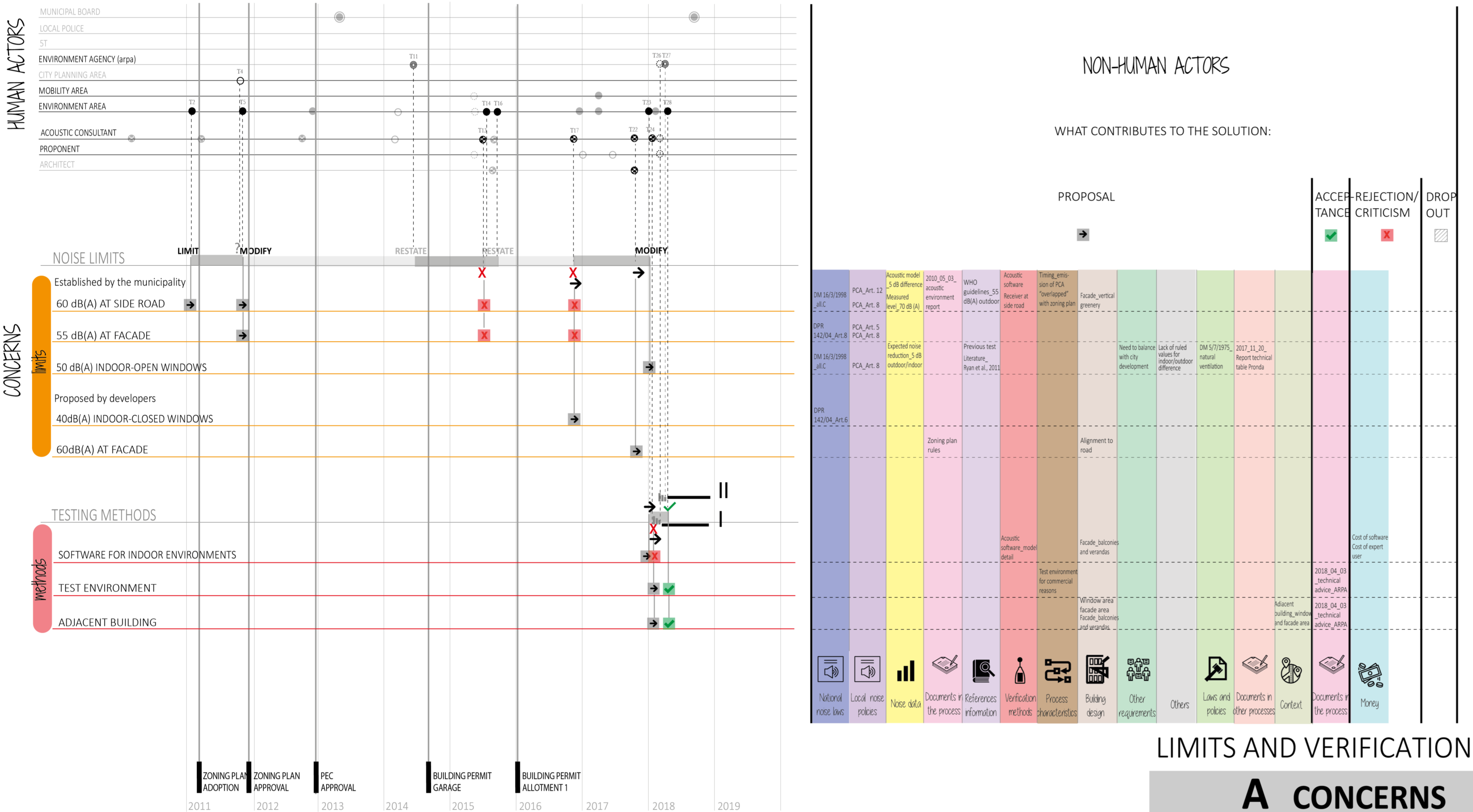

Figure 6.16 - "concern" map on the *matter of concern* related to noise limits and verification modalities. The left side of the image reports a zoom on all the proposed solutions, while the right side reports all the actor which were named in the analyzed documents and interviews as affecting the choice of proposing, discarding, accepting or dropping out a certain solution

6.5.2 How to verify the new limits? The “crafting” of a testing method

As seen in the previous Subsection, the modification of requirements in terms of verification points opened a new *matter of concern*, as a modification in verification modalities is required.

It has been reported in the previous subsection that the acoustic environment report of October 2017 [T22] while presenting the software simulations to evaluate the effects of a screen placed in the veranda (see Subsection 6.4.3), put in light the limitation of the software, which, as designed for noise calculation of quite wide outdoor areas, does not allow for a detailed modelling of the building façade, although allowing for the calculation of multiple sound reflections.

The response of the Environment Area of the 11th January 2018 [T23], after suggesting the limit of 50 dB(A) to be measured indoor with open windows, indicated therefore that:

“Considering what stated before, it is therefore necessary to proceed with the revision of the proposed simulation model, possibly considering different design options and using an appropriate software for indoor acoustics simulations, also supported by real data obtained through sample surveys in analogous conditions, considering the outcomes of the mitigation measures related to allotment 1 and the mitigation goals as required in the previous response”[129]

However, as reported by the acoustic consultant, the use of the software required by the Environment Area posed considerable issues to its practice.

“I Said that I could do analytical calculations and if they wanted I could compare it with a less-detailed analysis with the software I used before. But I do not invest thousands of euros to buy the requested simulation software and also hire a person who is capable to use it”[130]

It is then proposed a different verification modality:

“So, we could do some tests [...]. There is a sample environment in the construction site, which has been realized also for other reasons, however it is towards the inner courtyard, as working on the outer front is more complicated”[131]

“We made a sample environment, that however was also needed for the selling, and we did the measurements there [...] it reproduces a living room and as a window that lead to a veranda [...]

[129] In the original: *“Alla luce di quanto sopra, si rende pertanto necessario procedere con la revisione della modellazione propeosta, contemplando eventualmente diverse soluzioni progettuali e utilizzando un idoneo software per acustica degli spazi confinati, anche supportato da dati reali ottenuti con rilievi campione in condizioni analoghe, considerando gli esiti degli interventi di risanamento relativi al lotto 1 e gli obiettivi di risanamento cosi come puntualizzati nel presente parere”*

[130] Interview conducted on 28th February 2018

[131] *Idem*

… that sample environment will be used also for showing to the possible buyers, so, let's say… are not wasted money"[132]

It was therefore decided to use such environment (See Figure 6.17a) to conduct *in-situ* measurements of the effectiveness of the screens in the verandas. However, the location of the sample environment towards the indoor courtyard made it impossible to directly measure the indoor levels due to traffic noise. It was therefore necessary to pass through the measurement of the Weighted Standardised Level Difference $D_{2m,nT,W}$, which is an index for the sound insulation provided by a facade, hence expressing a characteristics of the building envelope, independently from the surrounding context[133]. As reported by the acoustic consultant:

"Since the sample environment has a veranda, we did the measurements to provide the required verifications. We did a series of tests of the sound insulation of the façade [$D_{2m,nT,W}$], in various configurations […]the facade insulation [$D_{2m,nT,W}$] is an index, so it is a value that should not be influenced by the position of the facade we are testing. I can estimate then what will be the indoor level. I use as input data the outdoor levels that we measured in corso Moncalieri*, and then I attenuate them according to the index I have obtained for the façade insulation from the measurements"* [134]

The tests, originally conducted to verify the effectiveness of the screen posed inside the veranda, leaded however to unexpected results, which made unnecessary the use of such screens.

"We tested 9 different configurations […] and they opened new developments. The most significant configurations have been those that gave lower results for the insulation, in which we had removed the screen and the window leading to the veranda was open, and the veranda was also open[135]

The report presented to the Environment area on 26th January 2018 [T 24] reported indeed an indoor noise level of 51.5 dB(A), for a situation with the veranda completely opened, without the use of the inner screen, and the window opened enough to guarantee the required natural ventilation. The level had been calculated with the outdoor noise levels measured at the time, so without mitigation measures at source apart from the pedestrian crossing approved for allotment 1, which had already been realized at the time[136].

[132] Interview conducted on 3rd March 2018

[133] EN ISO 12354-3:2016 "Building acoustics. Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound."

[134] Interview conducted on 28th February 2018

[135] *Idem*

[136] *In situ* observation, 7th March 2018; Interview with the proponent conducted on 10th March 2019;

"So if I already have 51.1 dB(A) now, and I need to have 50 dB(A), how can all the intervention at source do not provide a reduction of 1.5 dB? I think this analysis can lead to the conclusion that indoor you have less than 50 dB, so other intervention at the façade are not needed"[137]

Further tests were then conducted to have a measurement on the road side, hence directly measuring the indoor noise level generated by the traffic on *corso Moncalieri*. It was therefore identified a building next to the building site, situated along the same road alignment, as possible approximation of the situation foreseen for the future flats facing the avenue (see Figure 6.17b).

"We made an arrangement with this man living in the adjacent building, so that he went in an hotel for one night… we paid, and he left the house and we could enter the living room… so we placed a noise level meter inside the house , keeping the windows open for the required natural ventilation, and then we placed a noise level meter on the balcony, outside, for the whole night. So in this case we have a finished house, facing the road"[138]

"So we made the measurements there. There is a room that has a window and a French window leading on the balcony. We left the two sound level meter for all the night. The window was open and the French window closed"[139]

The choice of a measuring point in a different building posed of course some conditions, in order to an acceptable estimation of the designed one:

"We compared the two buildings. The volumes, the surfaces, the surface of the façade and of the glazed area, and we saw that are comparable environments, as the glazed surfaces and the ratio between glazed and opaque surfaces are comparable. The test environment it is less profound, it is almost 4 m, while the ones in the designed buildings are almost 6. This means that the measuring point is closer to the road, so at worst it is conservative condition."[140]

The measurement in the adjacent building, conducted during the reference period for night-time levels (22.00-6.00), leaded to a result of 9.5 dB difference between indoor and outdoor level (hence in line with the 5-15 dB range reported in literature, but considerably higher than the 5 dB established as expected difference as a conclusion of the technical panel, as seen before)[141].

"We measured the equivalent level in all the night time period. It was of 64 dB(A) outside and 54.5 dB(A) indoor, so with a delta of 9.5 dB, obtained only by

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[137] Interview with the acoustic consultant conducted on 28th February 2018

[138] Interview with the proponent conducted on 3rd March 2018

[139] Interview with the acoustic consultant conducted on 28th February 2018

[140] *Idem*

[141] Integration to noise climate report, 26th January 2018

moving the receiver from outside to the centre of the room. So if we have 54.5 dB(A) indoor, and the estimated reduction for the asphalt is 5 dB, well, we don't have a lot of margin, but we get to 49.5 dB(A), so below the required 50 dB(A), I should not need to provide other previsions now"[142]

The report presented by the proponent on the 26th January 2018 [T24] reported such results, specifying how it can be considered acceptable estimations of the situations that will be found in the designed building:

"The living environments that face corso Moncalieri *are of three different types. Type 1 has the balcony and the veranda, type 2 has the balcony, type 3 has nothing. For type 1, we made the measurements in the test environment. For type 2, we can use those measurements again, if we consider that during the measurements the veranda was almost all open, so it was almost like an open balcony. Moreover, the parapet of the balconies in reality is more massive than the glass that you have in the lower part of the veranda, so we can say that the balcony is comparable to an open veranda […]. Type 3 can be compared to the adjacent building, because it has a very small balcony, which does not create any significant barrier with respect to the noise coming from the road below, the façade is basically open"* [143]

(a)


[142] Interview with the acoustic consultant conducted on 28th February 2018; the same considerations are also reported in the Integration to noise climate report, 26th January 2018

[143] *Idem*

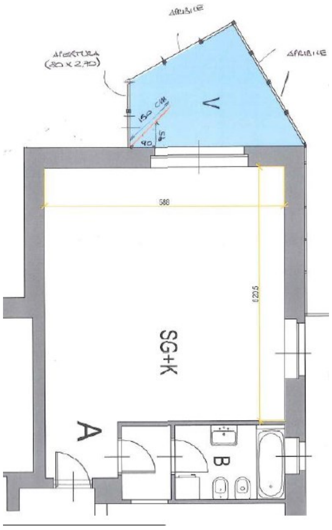
(b)  (c) 

Figure 6.17- (a) test environment used for measurements; (b) plan of the test environment, with the veranda marked in light blue; (c) adjacent building with a red mark around the room used for the measurements (extrapolated from acoustic environment report, January 2018)

Figure 6.18 shows a schematic analysis of the results presented by the noise report on 26th January 2018 and further explained by the interviews with the proponent and the acoustic consultant. The figure proposes a graphical synthesis of what described so far in this subsection, showing the “entanglement” of actors and conditions which were necessary in order to provide a test of mitigation measures through *in-situ* measurements.

As can be seen in the map , the grey label representing the action of providing data, on the right side of the map, is conducted by the proponent and the acoustic consultant (blue labels) and involves a series of non-human actors classified into different categories. The action of providing data is done through two testing modalities, namely measurements in test environment and in adjacent building (red labels), that in turn are caused by a series of actors related to the contingency of the specific process, in particular to the characteristics of the building (beige labels) such as the conformation of the test environment or of the building façade. Moreover, the measurements in an adjacent building could be done thanks to the specific characteristics of its design (greenish labels) and to the availability of one of its inhabitants (blue label). Moreover, the measurements in adjacent building, being direct measures of indoor and outdoor noise levels due to traffic noise were done following national law (DPR 16/3/1998, violet label) while the measurements in the test environment, as seen before, had to be conducted through the measurement of another metric (Weighted Standardised Level Difference $D_{2m,nT,W}$) for which indications were retrieved from ISO norms (fuchsia label). Finally, the measurements resulted in the data of measured noise level difference for facades with no balconies and veranda, deriving from adjacent building measurements, and expected indoor noise level with open windows of 51.5 dB for facades with balcony or veranda, derived from measurements in test environment (yellow labels on the right side of the map).

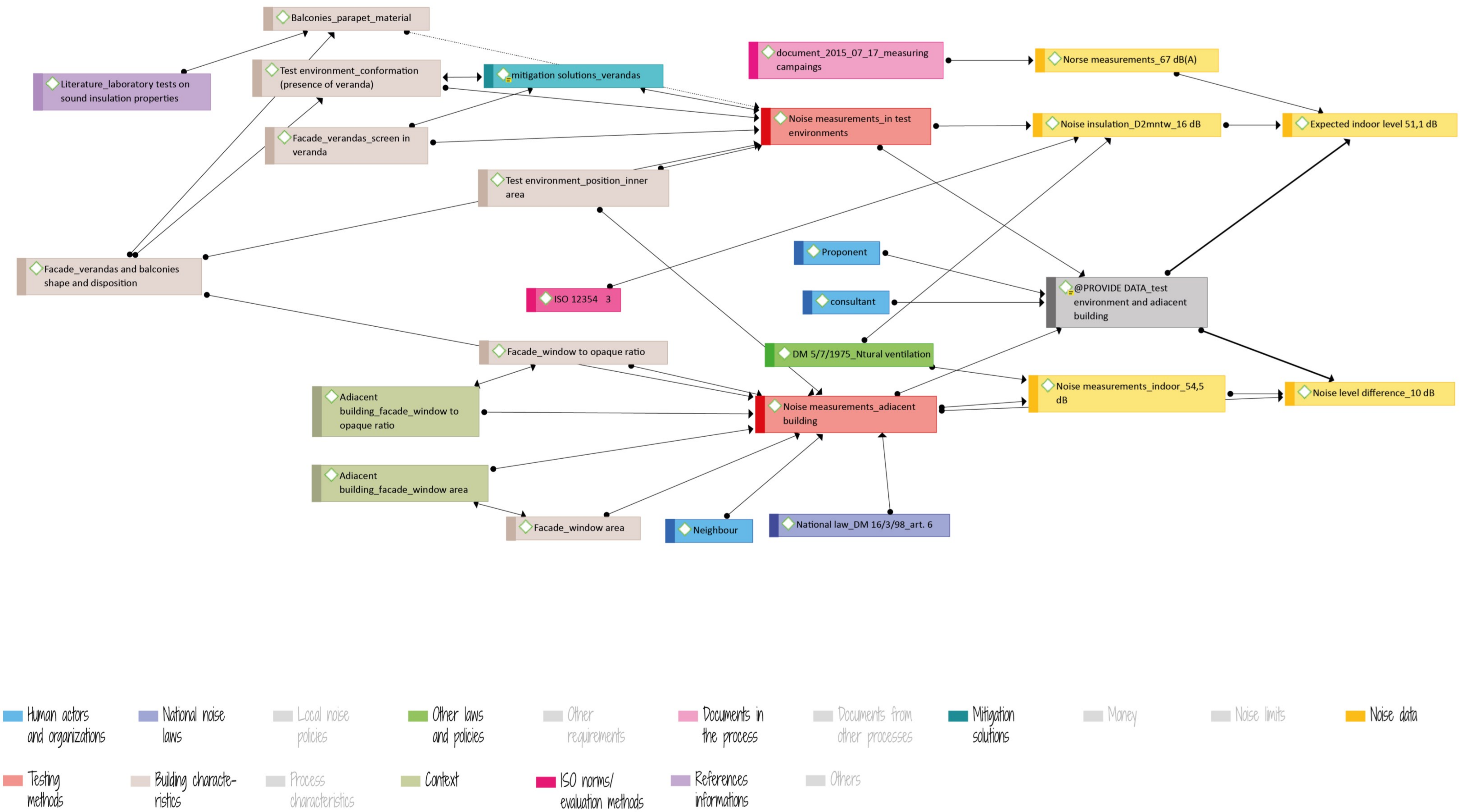


Figure 6.18- Network of actors involved in the *in-situ* measurements presented by the proponent and the acoustic consultant in order to estimate the indoor noise levels with open windows in the foreseen apartments

After the reception of the report from the proponent, the Environment Area requested the help of *ARPA* in order to obtain a check of the measurement from a third parties. *ARPA* therefore performed new measurements on 7-12 March 2018, repeating the measurements done by the acoustic consultant [T26].

The *in-situ* measurements conducted by *ARPA*, to which I took part as observer, added some modifications to the measurements conducted by the acoustic consultant, with respect to type and positioning of the sound source when testing the façade insulation of the sample environment, following the ISO 140-5 norm[144], which regulates the in-field measurement of the façade sound insulation. This leaded to some complications in the realization of the measurements, in terms of positioning of the source in order to allow for an adequate difference between the background noise and the noise emitted by the source, as measured inside the room. Such requirements could be fulfilled thanks to the use of machineries present on the building site (see Figure 6.19).

The sound insulation provided by the façade was moreover normalized with respect to the reverberation time of the room[145], according to what requested by the ISO norms[146], leading to higher indoor noise levels with respect to the ones provided by the acoustic consultant.

However, the measurement conducted by *ARPA* leaded to a result which was considered as acceptably close to the one of the report provided by the proponent, since the façade insulation reported by the proponent was obtained through a partial closure of the veranda, which could however allow for enough natural ventilation.

The normalization with respect to measured indoor reverberation time also influenced the calculation of expected indoor noise levels, providing hiher levels with respect to the report of the acoustic consultant. However, lower outdoor noise levels were measured by *ARPA* with respect to the precautionary ones used by the acoustic consultant. An outdoor noise level of 65 dB(A), was detected by *ARPA* and used in the calculations, 2 dB lower than the level considered by the acoustic consultant, who referred to the monitoring performed during June 2015, using the higher value registered during the night.[147]

The calculations performed by *ARPA* leaded in the end to an estimated indoor level of 54.5 dB(A), hence higher than the one reported by the acoustic consultant, although still low enough to guarantee the requested limit of 50 dB(A) with the application of source mitigation measures.

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[144] ISO 140-5:1998 Acoustics — Measurement of sound insulation in buildings and of building elements — Part 5: Field measurements of airborne sound insulation of façade elements and façades

[145] The reverberation time is the time required for a sound to decay of 60 dB after the stop of the emission from the sound source. The reverberation time is higher when the environment is highly reflective and therefore the sound bounce multiple times non the surfaces. A high reverberation time in an environment hence means a high quantity of reflections, which contribute to increase the noise level.

[146] EN ISO 12354-3:2016 “Building acoustics. Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound.”

[147] In-field observations, 7th March 2018; e-mail exchange and phone interview with *ARPA* engineer, 13-14th March 2019

Finally, the measurement conducted by *ARPA* on the adjacent building led to a difference of 10 dB between indoor and outdoor noise levels (compared to the 9.5 dB measured by the acoustic consultant), hence confirming the previous measurements.

(a) (b) (c)

Figure 6.19- (a) first attempt of positioning of the sound source, as seen from inside the indoor environment; (b) repositioning the sound source with the crane; (c) positioning of the outdoor receiver.

The results of the measurements put therefore in light how it could be estimated that a reduction of 5 dB of the outdoor noise would allow to respect the 50 dB(A) limit inside the living environments, hence making it a less strict requirement than the 55 dB(A) at the facade, originally requested by the local policies[148].

[148] The 50 dB(A) indoor limit hence proved to be less strict than the 55 dB(A) limit at facade, and not an equivalent limit, as could be inferred from the report of the technical panel held for the *ZUT "8.7 Pronda"*. This was on the other hand expected by the Environment Area, as reported in the interview with a team manager

Figure 6.20 shows a graphical synthesis of what described in the subsection, showing the "entanglement" of actors and conditions which were necessary in order to perform the verification measurements.

After *ARPA* communicated the results of the measurements on 3rd April 2018 [T27], the Environment Area produced a response on 23rd April 2018 [T28], which, seen also the "intrinsic uncertainties related to the protection provided by the facades", gave a favourable response to the release of the building permit, provided that

"Are realized and tested the mitigation measures on the mobility system, of which in the response of the 5th April 2017, i.e. the portal with messages to enhance aware behaviour aiming at the reduction of vehicles speed. The proponent will then have the possibility to propose other mitigation measures, to be realized to reach the noise reduction already foreseen for the use of the asphalt;

Is provided a bank guarantee [...] for the realization of sound absorbing asphalt of the Rubber Asphalt type"

It is therefore basically maintained the proposal of rescheduling of the mitigation solutions required in April 2017 (see Subsection 6.4.1) and the related performance-related obligations. However, the results of the measurements would then lead, in the end, to a step forward in the process with the modification to the *PEC* agreement, in September 2018 [T29], as will be shown in the following Section.

Figure 6.20 shows a schematic representation of the network of actors involved in the measurements verification conducted by *ARPA* in order to verify the measurements provided by the acoustic consultant. As shown in Figure 6.18 for the measurements conducted by the acoustic consultant, also in this case the action of checking data (grey label) is linked on the left side to the network of actors that contributed to such data providing and on the right side to the results provided (yellow labels), a part from the fact that, as previously said, the ISO standard 140-5 is used as a reference for the measurement of Weighted Standardised Level Difference $D_{2m,nT,W}$, (fuchsia label) and this required a specific positioning of the sound source which was made possible by a crane used on the building site (brown label). Moreover, the measurements in the adjacent building were also used to derive a reference outdoor level measured according to DM 16/3/1998 (violet label) that could not be performed on the building site, as the lack of the building façade together with the presence of the scaffolding (brown labels on the lower left side

conducted on the 25th January 2018, when the expected reduction of 5 dB was assumed as literature reference, instead of higher reductions which could be found in the same literature (see Subsection 6.5.1).

of the map) would lead to a series of noise screenings and reflections that would made the result unrealistic for the foreseen building.

II

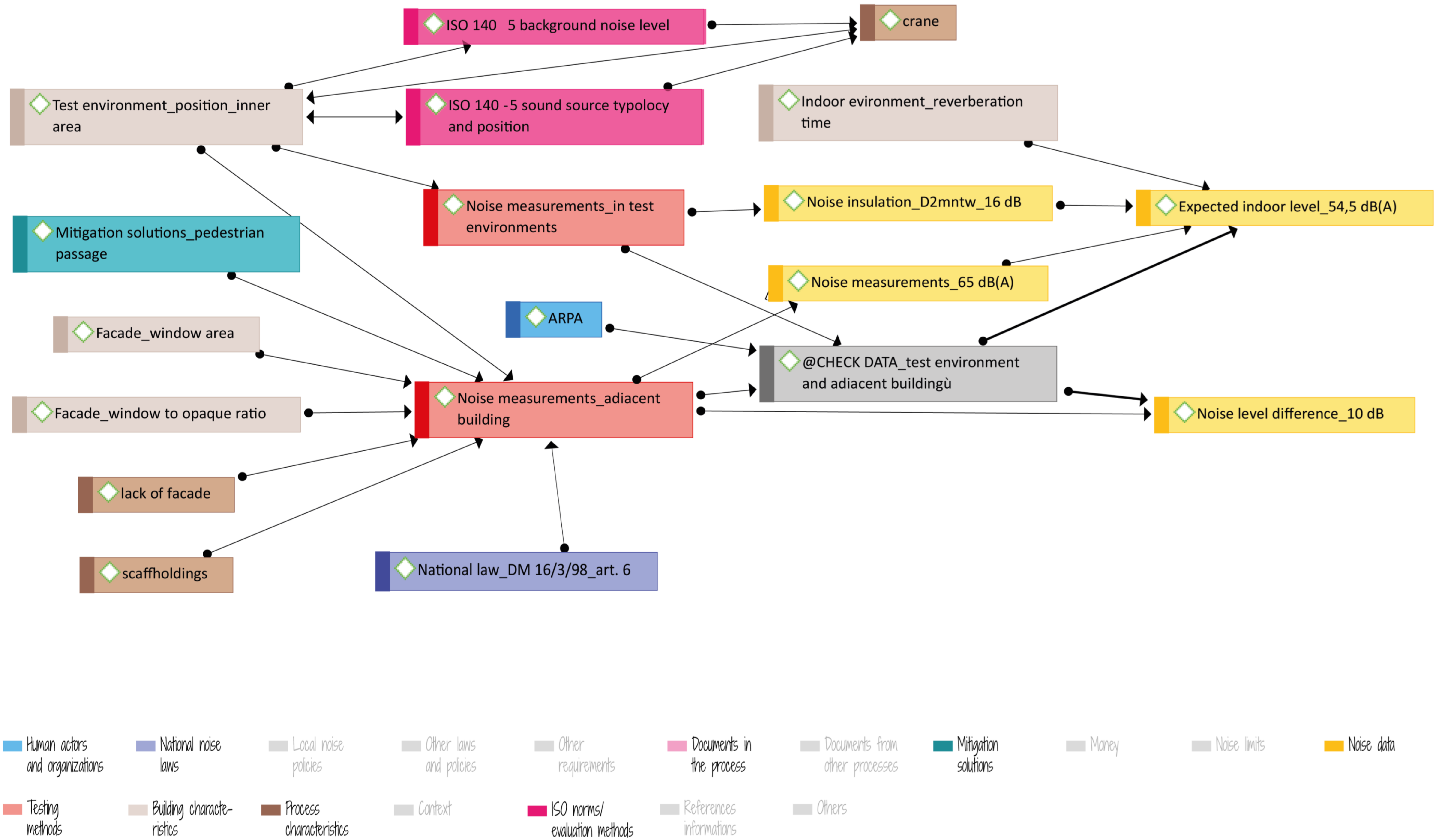


Figure 6.20: Network of actors involved in the measurements verification performed by *ARPA*

The *matter of concern* presented in this subsection and the maps of actors which were entangled in the production and verification of *in-situ* measurements **showed how the verification modalities of the noise levels in this case were not "black-boxed".** The setting of new verification setups (i.e. indoor with open windows) modified also the requirements in terms of verification modalities, and **the complex contingent situation** imposed the use of *in-situ* measurements in an on-going building site. **This required a series of devices and approximations and the measurements were therefore the result of a network of actors**, such as the "adaptation" of different metrics (i.e. the sound insulation of façade) and a series of contingencies of the specific context.

Such findings support what claimed by Rydin (Rydin 2013) when underlining that verification modalities, usually emphasized as black-boxes that create incontestable evidence claim, can however be not fully closed and fixed, and therefore still open to controversies and negotiations which can greatly affect the process outcomes.

Empirical evidences from the present case studies therefore sustain Rydin's claim that more awareness is needed on verification modalities and how they may affect or being affected by other actors and design solutions, also by stakeholders that are not acoustic experts. This would enhance the careful integration of noise mitigation aspects in the process and an informed negotiation between stakeholders.

6.6 Towards the next building permit

With a deliberation dated 18th September 2018 [T29], the city council, approving the executive project for the infrastructure works to be realized by the proponent, approved also some modifications to the *PEC* agreement signed on April 2013 [T8], including the obligations posed on the noise mitigations measures. Following the unilateral obligation signed by the proponent, the deliberation established, as conditions for the viability of allotment 1 and the granting of building permit for allotment 2: the realization of the sound absorbing asphalt before the end of the *PEC* validity (4th April 2023), upon bank guarantees; the development of the executive project, costs calculations and ordering of the portal for messages to promote speed reduction, to be sent to the transports company (5T) within one month from the new agreement; the installation at their own responsibility and expenses, of two lighting speed indicators on the avenue, "Whose efficacy will have to be verified".

It is therefore accepted the request of modification of the timing for the realization of the sound absorbing asphalt. The mitigation measures which are required to move forward in the process focused therefore on info-mobility measures, for which however no performance obligations are set. Moreover, the timing of the construction site is freed from the bond to the realization of the portal by the municipality, which was the main reason of opposition by the proponents to such mitigation measure.

This decision leaded to the definitive closure of the controversy on type and timing of mitigation solutions. The definition of the modalities of realization of the portal and the speed indicators was still needed in order to achieve the granting of the building permit of allotment 2. This step mobilized again a quite complex network of actors, that required additional time for the process to be unlocked, although without raising important controversies.

Figure 6.21 shows the network of actors mobilized in the definition of both speed indicators and portal, derived from an *in-situ* observation and interviews with the proponent and the Mobility and Infrastructure area[149]. As can be seen from the map, the actors involved belong mainly to the "context" category (greenish labels), indicating how the choice of this type of mitigation solutions should entail a careful examination of the specific context. Moreover, different companies and local offices are involved (blue labels), showing how, as said, info-mobility solutions need to be carefully planned and scheduled since the early stages of the process.

This observation is also supported by the fact that, for the portal, new issues were raised on the costs of the first project, proposed by the local mobility agency 5T, considered as too expensive by the mobility area. The realization of the portal foundations and structure was then demanded to the proponent, in order to obtain a cheaper project thanks to the regional price list for building works ("preziario regionale") that binds costs of work for private building companies to defined standards[150].

Therefore, **info-mobility solutions** may be an answer to the requirement of mitigation solutions at source, but they **should be planned and defined, both in terms of design and of realization timing, since the first stages of the process**. **The infrastructure project that is delivered as part of the executive planning instrument project should be evaluated as an important intermediary in translating the noise mitigation requirements into the project,** aligning the goals of the two local offices (Mobility and Environment area) and of the proponents.

[149] *In-situ* observation of meeting on the building site for evaluation of the positioning of portal and speed indicators, 6th February 2019; interview with the proponent conducted on 10th March 2019; email exchanges with employee of the Mobility and Infrastructure Area, conducted between March and July 2019.

[150] interview with the proponent conducted on 10th March 2019; email exchanges with employee of the Mobility and Infrastructure Area, conducted between March and July 2019.

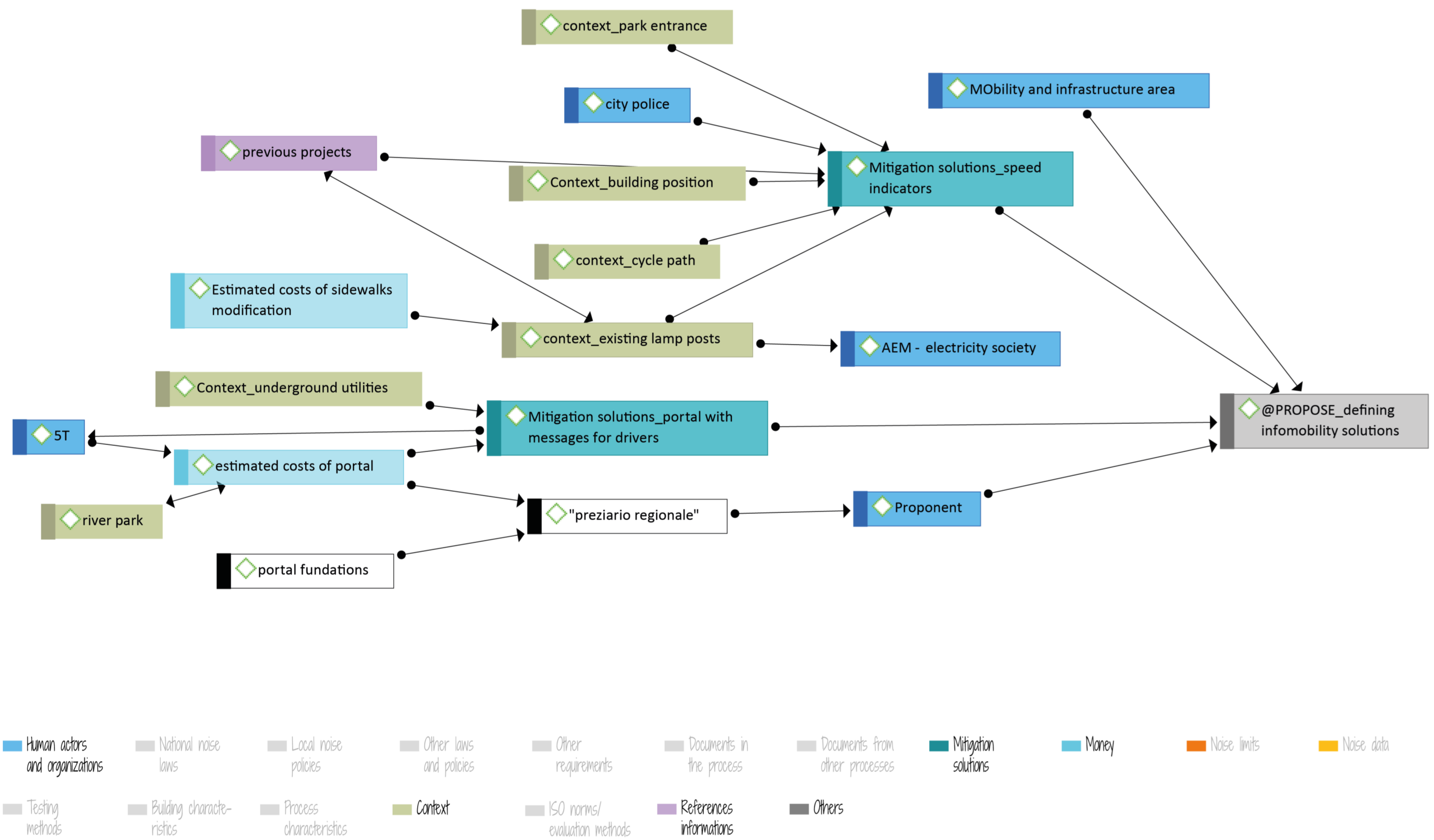


Figure 6.21-network of actors involved in the definition of the info-mobility solutions necessary for granting of building permit for allotment 2

6.7 Following policies in the process

In this section, the second type of zoom defined in Chapter 4 (see Subsection 4.3.2), “following specific actors”, is used to follow in particular noise mitigation policies and other policies and requirements which were involved during the analysed process. The maps are reported in Figure 6.22 and 6.23, which focus on noise mitigation policies and other policies and requirements, respectively.

Moreover, in the following part of the section are individuated the moments in which “green lights”, hence “unlocking” in the process with respect to noise mitigation issues were achieved, exploring the actors that contributed to such actions (Figure 6.24 and 6.25).

Figure 6.22 focuses on the presence of noise mitigation policies through the process. as resulting from the documents analysis. By looking at the map, wit can be seen how the national laws involved are the implementing decrees related to infrastructure noise. In particular, the involved decrees are the Ministry Decree DM 16/3/1998 that sets operative indications for noise measurements, while the article of the Presidential Decree DPR 142/04 that is mainly named during the process is art. 8, which is the one that specifies that the costs for mitigation measures have to be borne by the proponent (see Subsection 5.1.3). In this sense, the national law does not act in the process by setting specific limits, nor by giving operative indications on how to design noise mitigation solutions.

In Figure 6.22 it can be seen that national norms are almost always accompanied by local norms, in particular to the articles related to the limits which are fixed for roads buffer areas and to the particular norms set by the city of Turin for the transformation areas (see Chapter 5). The limits set by local policies overcome also the ones identified by the national norm DPR 142/04 that, at art. 6, suggested to use a 40 dB(A) indoor limit with close windows (see Subsection 5.1.3). Such article is only used once by the proponents, in order to propose the use of this limit, but is not considered by the local offices that, especially for transformation areas, aim at achieving quiet areas outdoor, sticking to the 55 dB(A) limit at façade level. Therefore, the agency of local policy and decisions taken by the local Environment area is much higher in determining the process outcomes than the one of national norms. This **shows on a real case study what was indicated as a “deflection to local control”** (Moore and Wilson 2014).

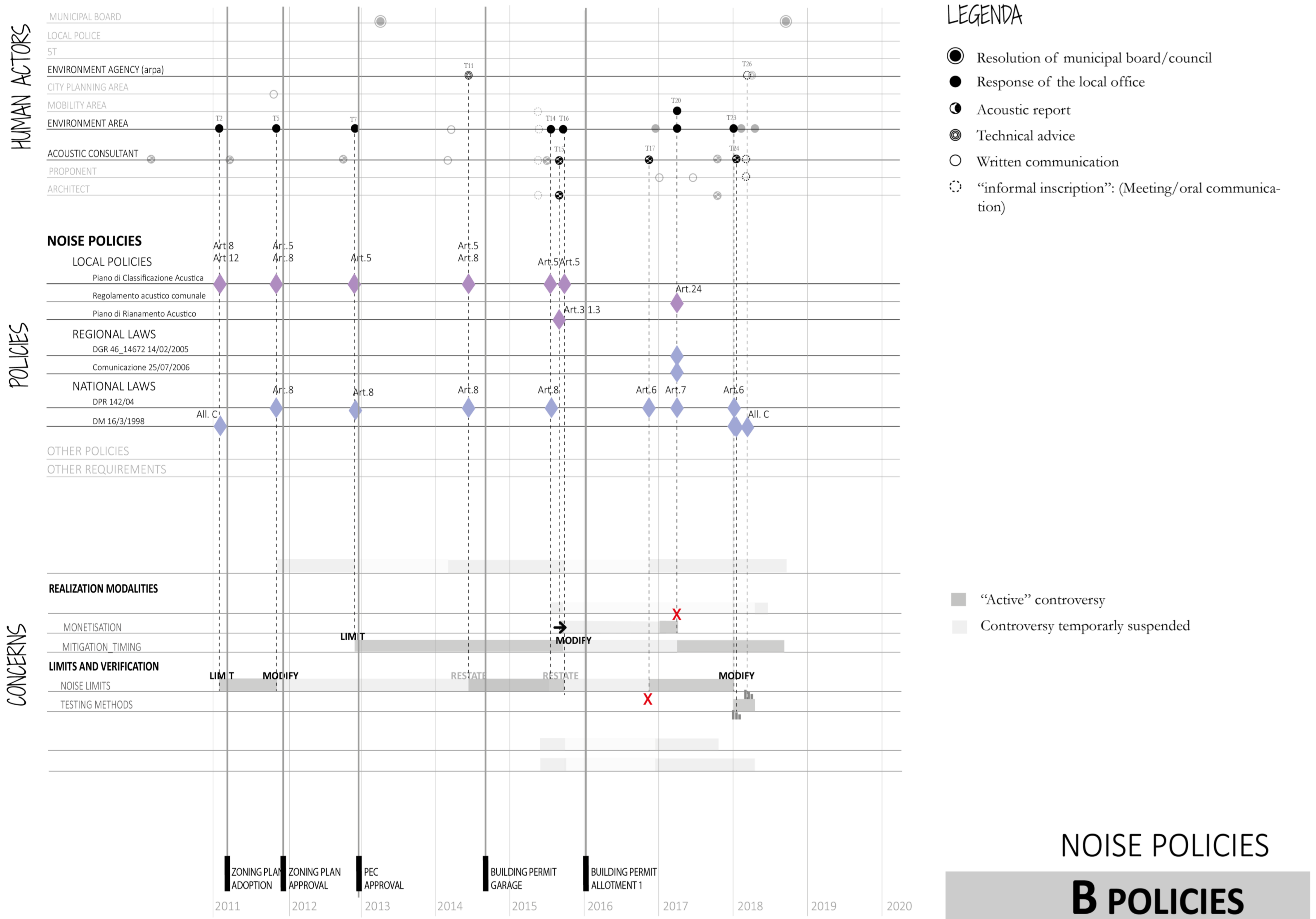


Figure 6.22– Following noise mitigation policies which were involved in noise mitigation issues through the process

Moreover, in Figure 6.22 it can also be seen the matters of concern in which the noise mitigation involved in the process acted. By looking at the map, it can be understood that even local policies, despite their importance in the process, only acted in the matters of concern related to the definition and restating of noise limits and in discussing and then opposing the monetization of mitigation solutions.

They do not have an agency in the definition of mitigation solutions, as can be also seen in Figure 6.10a and Figure 6.12, in which the *matters of concern* of mitigation solutions at source and at receiver are analysed more in-depth. They also do not have an agency in "unloking" the different phases of the process, a part from the granting of building permit 1 (point C in Figure 6.24), in which however they only act indirectly, by allowing the choices taken by the local Environment Area in order to solve the problem (see also Figure 6.25c). **Hence, policies did not work as "intermediaries" (Rydin 2013) between the Environment Area and the proponent, as they do not have a central role in allowing for an integration of noise mitigation goals into the project.**

Figure 6.23 puts in light the other norms and requirements which are not related to noise mitigation but were nevertheless involved in the process, as they needed to be *translated* with noise mitigation requirements. As can be seen from the map, the involved policies are mainly related to ventilation requirements and to regional and national policies that set requirements for building in areas of particular landscape value[151] and leaded to the regional landscape authorization that contributed in limiting further modification to the building façade in order to apply mitigation measures at receiver (see Subsection 6.4.3).

By looking at the *matters of concern* in which the policies and other requirements were involved, it can be seen that they mostly influenced the controversy on balconies and façade design, a part from the requirement of connection to underground utilities, which contributed to the controversies related to realization modalities of the mitigation measures (in particular in relation to the sound absorbing asphalt). This underlines how the limitations to noise mitigation measures are linked, as could be expected, to requirements which can be expected in a similar transformation, but that were not successfully translated with the noise mitigation requirements at the early stages of the process.

[151] Legge regionale 1 dicembre 2008, n. 32. "Provvedimenti urgenti di adeguamento al decreto legislativo 22 gennaio 2004, n. 42 (Codice dei beni culturali e del paesaggio, ai sensi dell'articolo 10 della legge 6 luglio 2002, n. 137)"

Decreto Legislativo 22 gennaio 2004, n. 42 "Codice dei beni culturali e del paesaggio, ai sensi dell'articolo 10 della legge 6 luglio 2002, n. 137"

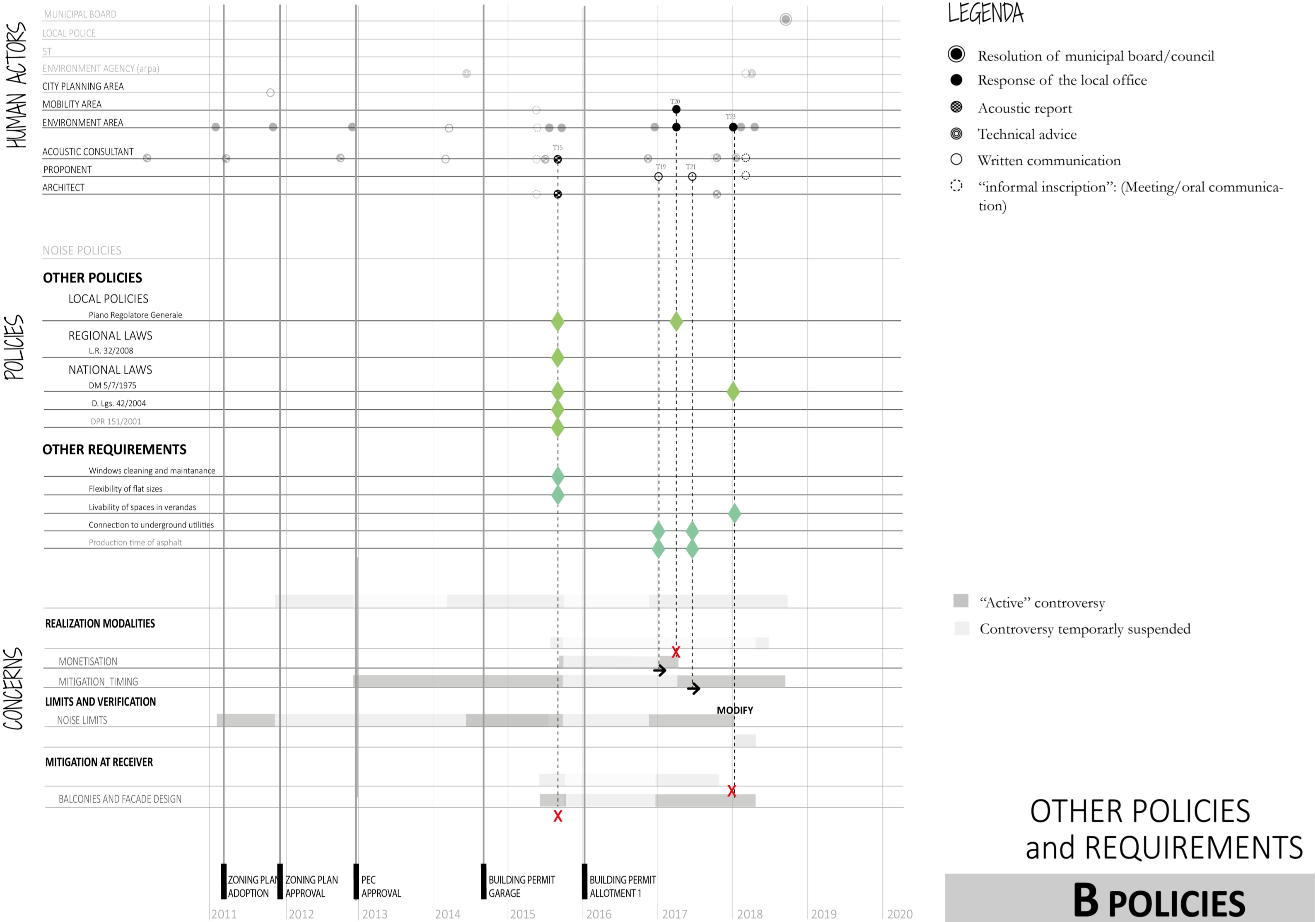


Figure 6.23 – Following other policies and requirements which were involved in noise mitigation issues through the process

Figure 6.24 shows the points in the process corresponding to "unlocking" in the process (green and orange dots in the lower part of the maps, "effects" part).

In Figure 6.25 are presented the networks of actors that "stabilized" in each of the five points underlined in Figure 6.24, in order to make those steps in the process possible (letters A-E). **The richness of colours in the networks underlines the variety of categories of actors that contributed to the decisions.** Noise mitigation policies (violet and purple labels) are present in some of the networks, but are just a part of it. The categories of actors involved include other requirements to which the project has to respond (green labels), results from calculations or estimations (yellow labels), but also specific characteristics of the building (beige labels) or of the context (light green labels) and the process in which it is realized (brown labels).

Moreover, it can be seen that as the process goes on, noise data (yellow labels) derived from literature or other sources of information (lilac labels) or directly from *in-field* measurements performed during the process gain importance. In network E it is even shown how the new noise limit established by the local Environment area (orange label) enters the network as an important actor in determining the unlocking of the process.

In all the moments identified by the five networks, therefore, the action of the local office was not determined by an undisputable indication set in the norms, that acted as only actor in the decision, but rather by a network of actors that results from **the efforts done to integrate different requirements an find possible solutions.**

As underlined by a technician of the Environment area, in charge of the process, in all those moments, the local office had to work in a "grey area" for which there were no guidelines or policies indication to follow[152]. In such cases, therefore, the local office acted as a "**designer" of policies, pushed by** the necessity to find ways to translate the noise mitigation requirements within **the complexity of the real process, hence showing on a real case study the "relational matrix" between project and norms** indicated by Imrie (Imrie 2007) in action.

It can therefore be witnessed the establishment of praxis which are likely to become conventional and lead to a future modification in the norms[153], hence confirming that **policies can be seen as a sociotechnical object just like projects**, as indicated by Moore and Wilson (Moore and Wilson 2014).

Moreover, the use of data from previous experiences and literature information plays an important role in such situations. It provides references on expected noise levels reduction, which act in defining, for instance, the acceptance of a partial mitigation project for granting the building permit for allotment one (network C) as well as the new indoor limit of 50 dB(A) (network D).

This puts in light on one hand **the need for an integrated work and enhanced communication among the different local offices**, so that different requirements do not lead to documents which bind aspects of the project that might be

[152] Interviews with a technician of the Environment Area, July 2017 and January 2018

[153] Interview with a technician of the Environment Area, January 2018

contradictory. On the other hand, the use of literature references when normative guidelines are not available highlights the need to make more data available so that more accurate predictions of noise levels reduction in different situations can be done (see Subsection 6.5.3). Hence, **experiences from environment agencies, practitioners and local offices should be disseminated, and more academic research might be devoted to provide data and support local offices in similar decisions.**

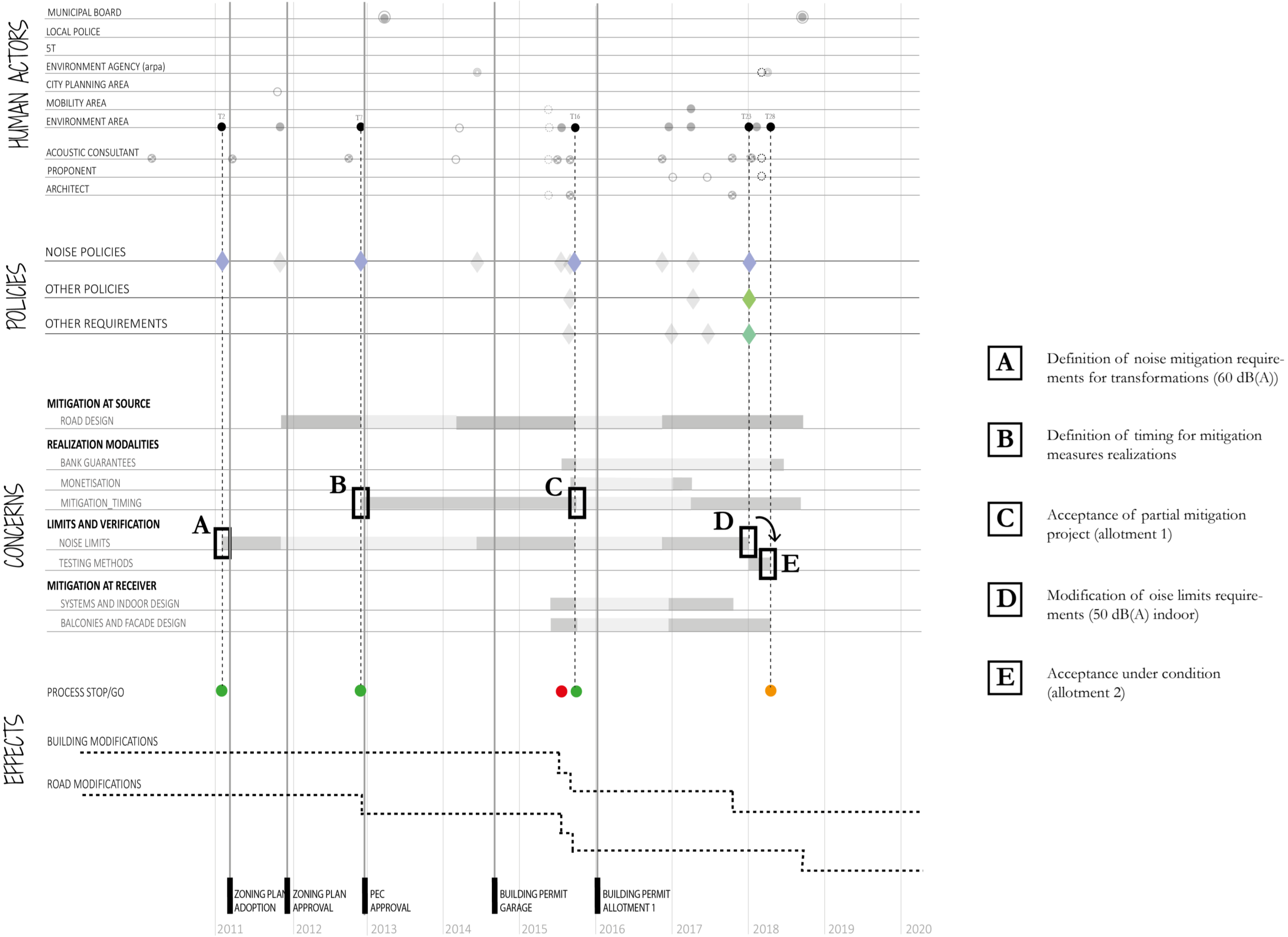
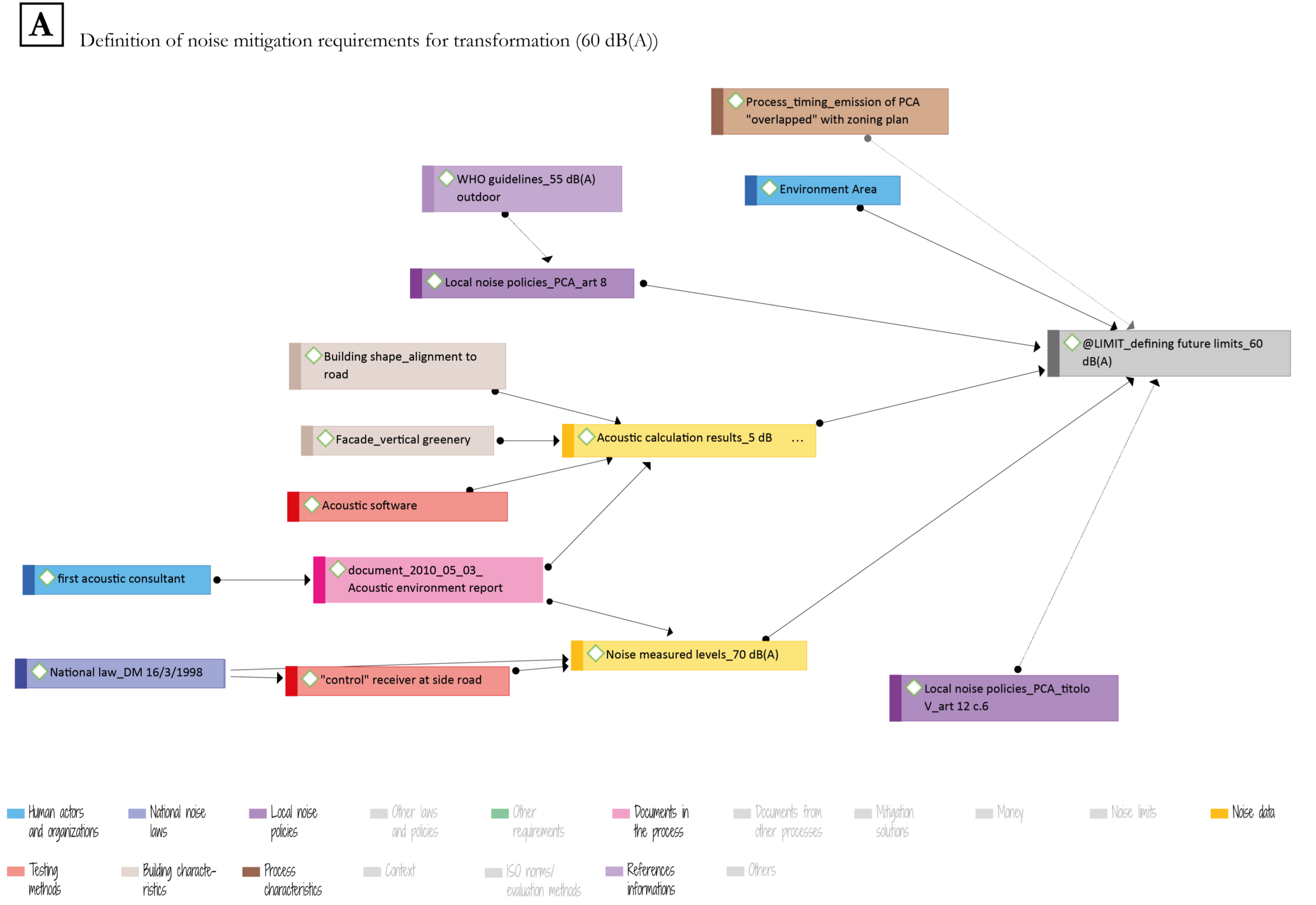
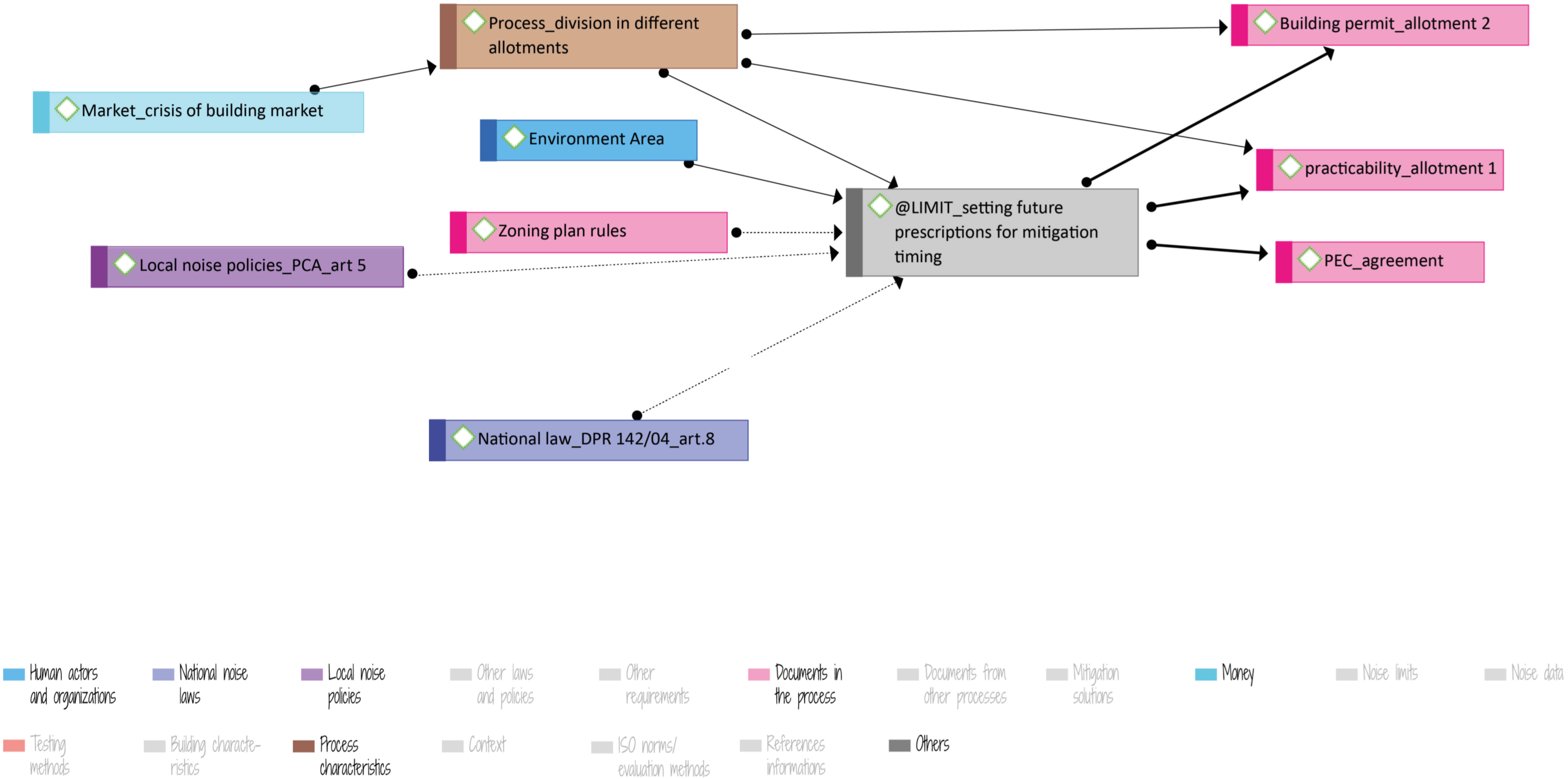


Figure 6.24 - Points in the process in which the local Environment area took decisions that allowed the closure of a bureaucratic phase of the process.

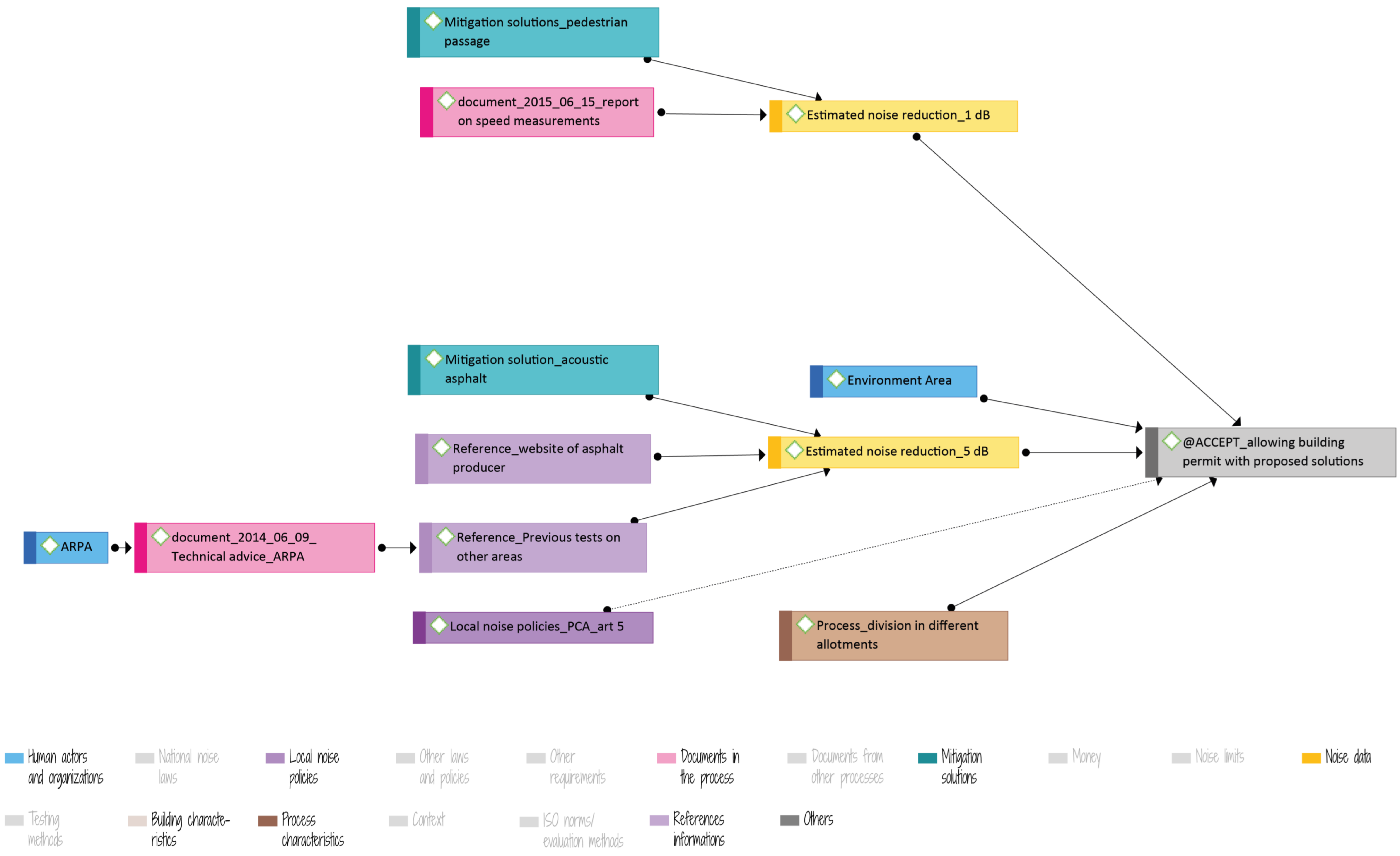


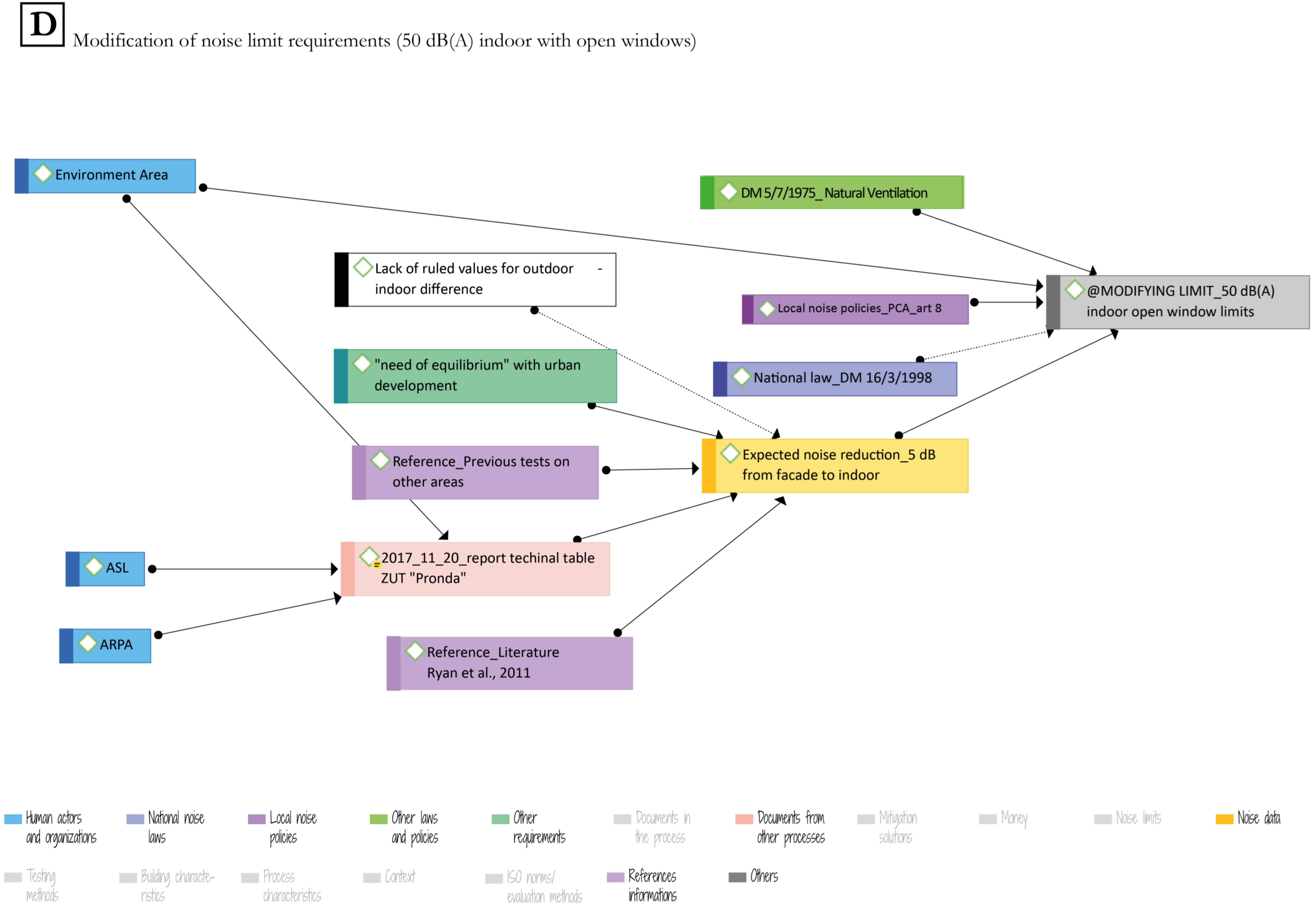
A
Definition of noise mitigation requirements for transformation (60 dB(A))
Process_timing_emission of PCA "overlapped" with zoning plan
WHO guidelines_55 dB(A) outdoor
Environment Area
Local noise policies_PCA_art 8
@LIMIT_defining future limits_60 dB(A)
Building shape_alignment to road
Facade_vertical greenery
Acoustic calculation results_5 dB ...
Acoustic software
first acoustic consultant
document_2010_05_03_ Acoustic environment report
National law_DM 16/3/1998
"control" receiver at side road
Noise measured levels_70 dB(A)
Local noise policies_PCA_titolo V_art 12 c.6
Human actors and organizations
National noise laws
Local noise policies
Other laws and policies
Other requirements
Documents in the process
Documents from other processes
Mitigation solutions
Money
Noise limits
Noise data
Testing methods
Building characte- ristics
Process characteristics
Context
ISO norms/ evaluation methods
References informations
Others

B Definition of timing for mitigation measures realization



C Acceptance of partial mitigation project




D
Modification of noise limit requirements (50 dB(A) indoor with open windows)
Environment Area
DM 5/7/1975_Natural Ventilation
Lack of ruled values for outdoor - indoor difference
Local noise policies_PCA_art 8
@MODIFYING LIMIT_50 dB(A) indoor open window limits
"need of equilibrium" with urban development
National law_DM 16/3/1998
Reference_Previous tests on other areas
Expected noise reduction_5 dB from facade to indoor
ASL
2017_11_20_report techinal table ZUT "Pronda"
ARPA
Reference_Literature Ryan et al., 2011
Human actors and organizations
National noise laws
Local noise policies
Other laws and policies
Other requirements
Documents in the process
Documents from other processes
Mitigation solutions
Money
Noise limits
Noise data
Testing methods
Building characteristics
Process characteristics
Context
ISO norms/ evaluation methods
References informations
Others

E Acceptance under condition (building permit for allotment 2)

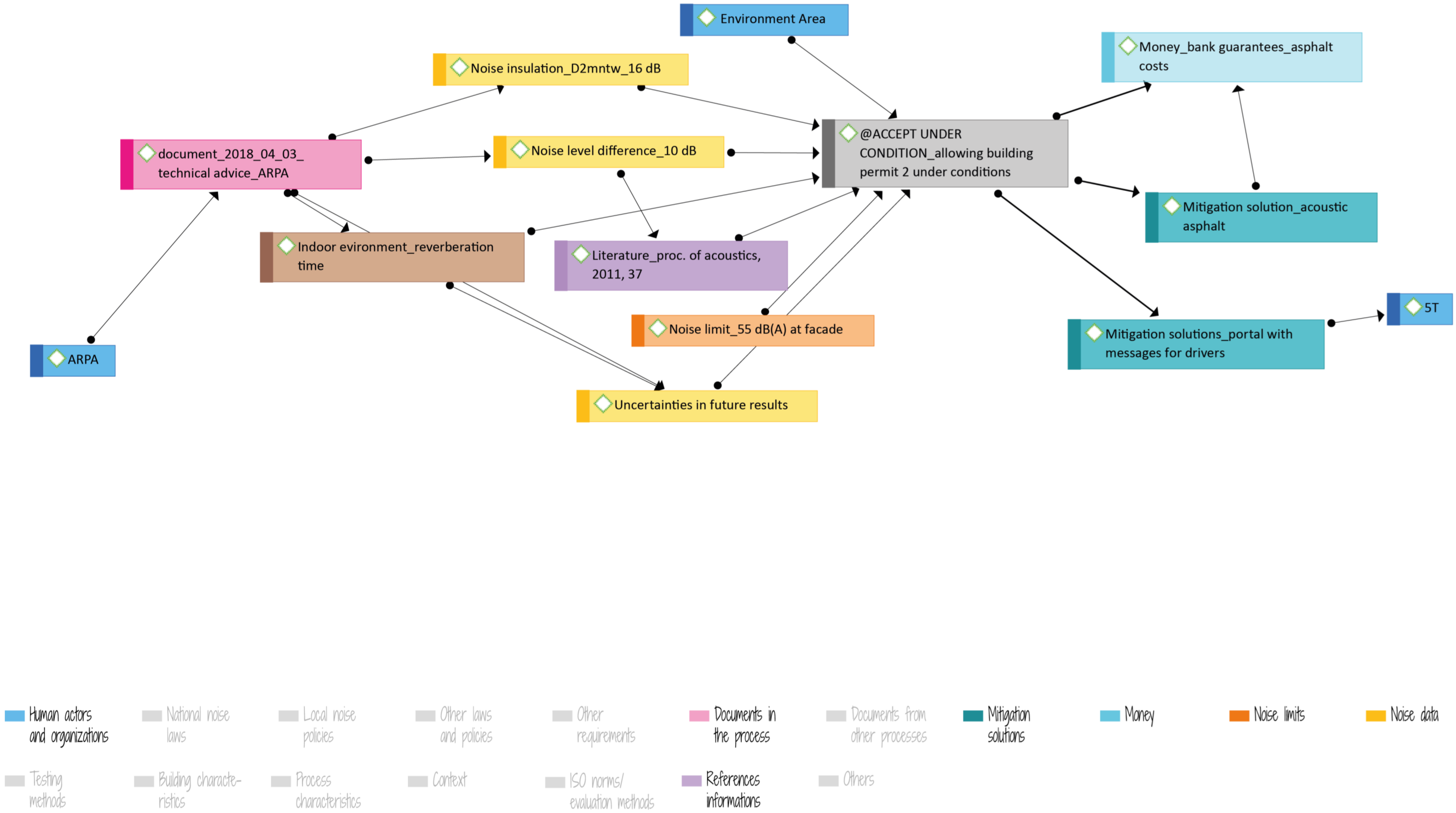


Figure 6.25 – Zooms on the points in the process in which the local Environment area acted as a "designer" of norms, showing the networks of actors that stabilized in each of the five moments, contributing to the decision

6.8 Summing up: answering to research questions

As a conclusion to the present chapter, in which a real case study was examined through the lenses “crafted” in Part I of the dissertation, this section sums up the findings of the analysis of the case-study, answering to the questions posed at the end of Chapter 2 (see Section 2.4).

It has been shown, through an overview of the process (see Figure 6.5), how in the examined case the cloud of documents related to the noise mitigation issue increasingly expanded as the transformation proceeded through the different decision phases.

During the Masterplan variation and the *PEC* phases, indeed, it can be seen in the cloud of actor what seems an almost linear process, in which to an acoustic report, presented as required by the law (see Chapter 5), correspond a positive response from the local office that gives the approval to the prosecution of the process. On the other hand, almost no material modifications on the project are determined in those early phases by the noise mitigation issue, if not a limited modification to the road design (the realization of a pedestrian crossing to reduce vehicles speed). This means that, although the process goes on, almost no mitigation solutions are integrated in the project in this phase. Hence there is no *translation* of noise mitigation requirements within the project.

On the contrary, in the following phases, when the building permit for the residential buildings are required, the number of exchanges between the proponent and the local Environment Area increases, going beyond the “linear” report-acceptance pattern, involving other exchanges (informal communications, meetings,…) and a higher number of actors, such as the local Mobility and infrastructures area and the regional environmental agency (*ARPA)*. As a consequence, the duration in time gets longer with respect to the “standard” expected ones. Few modifications are done to the building and are not crucial in allowing for the process to move on. This happens because the project has already been “stabilized” by the *PEC* approval, hence minor changes can be done to the building design.

The visualization provided in Figure 6.5 hence shows **a process which is almost the contrary to the “comprehensive strategy”** (Armando and Durbiano 2017) presented in Chapter 2 (see Section 2.3), in which the process is more complex at the beginning, as it is open to the inclusion of all the different instances, and aims for the translation of as many different goals as possible in the initial phases of the process, before the stabilization of the design. The increasing number of *Matters of concern* arising in the last phases of the process, as well as the delays, show on a real case study how the opposite of such strategy leads to complications in the process, hence supporting what presented by Armando and Durbiano (Armando and Durbiano 2017).

As far as the specific questions detailed in Section 2.4 are concerned, the following observation emerged from the analysis:

<u>Concerns and involved actors</u>

- **What are the arising concerns and which are the involved actors?**

As seen more in depth in the previous subsections, the arising concerns can be divided into four main categories: mitigation solutions at source (i.e. on the road), mitigation solutions at the receiver (i.e. at the building), realization modalities of such solutions, limits to be set and related verification modalities of noise levels (see Figure 6.5).

Going more in detail, the concerns on verification modalities are related to the mitigation solutions at source, as those are the ones which at the end determine a greater material effect on the project (see Figure 6.10) and depend from many different actors apart from the proponent, as they are closely connected to the realization of infrastructures and underground utilities. In particular, the info mobility solutions cannot be done without reaching an agreement with the local mobility and infrastructure area, as could be expected, and some of them cannot be done by the developer himself. The asphalt, on the contrary, can be realized by the developer without influencing the building design and can provide quite a good amount of noise reduction. However, the realization of such measures need to be carefully scheduled, as in this case the acceptance of the asphalt as a mitigation solution to be completed before the end of allotment 1 conflicted with other requirements, in particular with the connection to underground facilities for the following allotments and for an adjacent building site. This highlights the fact that, **although the realization of mitigation solutions in different allotments**, as proposed in this case, **might be a valuable solution to help developers acting in different steps, such realization should be driven by a comprehensive project**, **to be designed before the request of the different building permits**, in order to properly schedule the solutions so that they do not conflict with other issues.

As far as mitigation solutions at receiver are concerned, they did not determine the involvement of other local offices in the process. They also determined very small material effects on the project, as only solutions related to the layout of indoor rooms and to the use of ventilation and climatization systems could be implemented. The debate on noise mitigation solutions at the receiver could only be closed with the modification of the requested limits (see Subsection 6.5.2), that made further mitigation measures unnecessary. Nevertheless, the rejection of mitigation solutions at receiver was mainly linked to actors which are due to the specificity of the investigated project, and in particular to the late tackling of the issue of mitigation solution at facade. On the other hand, they involved a smaller network of human actors and organizations. It can therefore be assumed that **noise mitigation at receiver, involving the design of the building,** could be a good solution as they **may not require extra time and agreement with other parties for their realization,** since are integrated in the building design and realization. Of course, **this requires to tackle the issue at the very first design stages**.

Moreover, the proposal of mitigation solutions such as screens in verandas, as well as the verification of limits indoor living environments with open windows, lead to a concern related to verification modalities. Indeed, it requires the use of simulation software or test prototypes for *in-situ* measurements which are economically demanding and should be made clear to developers and consultants since the beginning. This means, of course, that the owning and mastering of certain software determines the inclusion or exclusion of acoustic consultants from similar projects, as the *in-situ* measuring is not always feasible on the building site and can be used only if certain favourable conditions are present, nevertheless leading to a series of necessary approximation (see Subsection 6.5.3). Therefore, more awareness should be enhanced in the involved stakeholders on verification modalities, in order to allow more informed choices since the initial stages of the process.

Figure 6.26 shows the complete list of all the categories of actors identified in the process through the analysis of documents and interviews. As can be seen, 18 different categories were identified, of which only six are directly related to the topic (namely national and local noise regulations, mitigation solutions, noise limits, noise data, testing methods), while the others are related to other requirements and policies to be integrated, specific characteristics of the investigated case study (building, process or context) or norms and other references that informed the choices of the stakeholders when praxis beyond established normative indications needed to be crafted.

It has been pointed out through the process how proposals or refusals of certain solutions by the Environment area or by the proponent may involve different categories of actors (see Figure 6.9 and Figure 6.11), such as noise-related policies for the Environment Area and building market needs and other normative requirements for the proponent, empirically showing the different "framework of interpretation" through which the same issue is observed (see Section 2.3).

Figure 6.26– Categories of actors identified in the whole process, together with the colour assigned to them in the maps.

Translation into common goals

- **When are noise mitigation measures translated with other goals?**
- **What measures are successfully translated and what measures are not?**
- **Which kind of actors are involved in the successful or failed translation?**

Mitigation solutions were not implemented in the process until the approval of the *PEC,* when a very small portion of the requested measures were added. Nevertheless, the process went through all the phases of masterplan variation and *PEC*. Hence in those phases, the "green lights" from the environment area did not correspond to material effects on the process.

Material effects on the project (which, as seen Chapter 2, happen when mitigation requirements are translated with other goal, reaching a common agreement on a project modification) can then be seen before the approvals of the building permit on allotment 1 and of the building permit on allotment 2, therefore the project is modified in later stages of the process.

By looking at the map zooming on the agreement on building permit 1 (Figure 6.25c) it can be seen that only the integration of mitigation measures at source contributed to the "green light" to building permit. In a similar way, in the following phase of the process, a new measure at receiver did not correspond to a step forward in the process (Figure 6.12). This is due to the fact that the integrated measures at receiver are related only to indoor and systems design, whose effect is not taken into account when the request is to respect the outdoor limit on every façade.

Mitigation solutions involving the design of the façade could not be implemented in this case, due to conflicting requirements. However, a part from the double skin façade that raised problems with different national norms, the unsuccessful translation of the other solutions were mainly due to the tardive attempt of their integration into the project. Hence, **similar solutions could be implemented in other transformations if considered in the early stages of the process,** when the design of the façade has not been secured jet by other provisions, especially in environmentally protected areas.

Moreover, by zooming on mitigation solutions at source (Figure 6.10), it can be noted that the most difficult to integrate were, as could be expected, the infomobility solution [i.e. solutions at source aimed at reducing noise through traffic speed control], which could not be realized by the developer themselves and therefore posed big problems with realization timing. The integration of other mitigation solutions *per se* was not contrasted by any actor; however, the realization modalities and timing of such solutions posed a series of difficulties due to decisions taken in the specific process. Hence, **such solutions may be suitable for integration in similar processes, provided a different definition of their realization timing.**

<u>**Policies**</u>

- **When and how do local and national policies act? Is there a "deflection to local control"?**

From the map presented in Figure 6.22, it was understood that the only national norms "involved" in the process are the implementing decrees related to infrastructure noise. Moreover, the decrees are involved in their parts that set operative indications for noise measurements or that specify that the costs for mitigation measures have to be borne by the proponent, without giving further indication or guidelines on noise mitigation actions. This leads to the expectation of a deflection to local control, and this is indeed the case, as it is shown in Figure 6.22 that national norms are always accompanied by local norms, which are the ones that sets the limits to be reached.

- **Do the policies work as "intermediaries"?**

Despite the importance that local noise policies have in the process, it can be seen from Figure 6.22 that they directly act only in the *matter of concern* of the definition and restating of noise limits and in discussing and then opposing the monetization of mitigation solutions.

They do not have an agency in the definition of mitigation solutions (see Figures 6.10a and 6.12, in which policies are not within the involved actors) and in the "unlocking" the different phases of the process, allowing it to move on. Hence **they do not work as "intermediaries" (Rydin 2013) between the Environment Area and the proponent, as they did not play a crucial role in integrating noise mitigation goals into the project**. At best, they can be acting indirectly, when allowing for certain implementation by the local offices within the specific case study (see also Figure 6.25)

- **Are the tools used to verify compliance with policies already "black boxed"? What can be learned on their functioning?**

It has been shown in Subsection 6.5.2 how **the verification modalities of the noise levels in this case were not "black-boxed"**, as a controversy emerged on the topic. The setting of a new limit modified also the requirements in terms of verification modalities, and the impossibility of the acoustic consultant to consent to the requirements in terms of software evaluation leaded to the use of *in-situ* measurements. However, the required timing for mitigation solutions imposed the use of *in-situ* measurements in an on-going building site requiring a series of devices and approximations and the measurements were therefore the result of a network of actors. Among those actors, important role had the "adaptation" of a different metrics with respect to the noise level (i.e. the sound insulation of façade) and a series of contingencies of the specific context.

Such findings support what claimed by Rydin (Rydin 2013) when underlining that verification modalities, emphasized as black-boxes that create incontestable evidence claim, are however often black boxes that are not fully closed, and therefore **still open to controversies and negotiations which can greatly affect the process outcomes.**

It therefore supports Rydin's claim that **more awareness is needed on verification modalities and how they may affect or being affected by other actors** and design solutions, also by stakeholders that are not acoustic experts. This would enhance the careful integration of noise mitigation aspects in the process and an informed negotiation between stakeholders

- **Is there a "relational matrix" between architecture project and norms?**

The absence of specific norms that work as "intermediaries" to translate the noise mitigation requests within the process gives rise to the need, for the local offices, to moving in a "grey area", progressively define the practice with which to integrate the noise mitigation issue within the specific process. This allows therefore to **witness the "relational matrix" between project and norm** (Imrie 2007) in action, as the norm (or better, the praxis of its implementation) progressively evolves under the push of contingent needs.

Indeed, it is shown in Figure 6.25 that all the points of "approval" or "approval under condition" for the project, from the acoustic point of view, correspond to the points in the process in which the local office acted as a "designer" of the norm, moving beyond policies indication.

- **If so, can we witness a network of actors "acting" in the definition of the norm? Which are the actors involved?**

Through the present chapter, it has been shown how all the steps done in implementing the application of noise mitigation policies, hence **defining new practices which may then become written policies, involve a whole network of**

actors (see Figure 6.15, 6.18, 6.25). It could therefore be seen a confirmation of what underlined by scholars who presented the norm as the result not of the decision of a unique actor, but as a balance within a stabilized network of actors (see Chapter 2).

The networks comprehend many different categories of human and non-human actors, of which noise mitigation policies are just one part. The categories of actors involved in such decisions comprehends instances to which the project had to respond, either because of specific characteristics of the area or of the process, or documents which have been previously produced in the process and that influenced further decisions, or because of other laws and requirements to which this type of transformation has to answer. Moreover, the use of data from previous experience and literature plays also an important role in informing the decisions.

This puts in light on one hand **the need for an integrated work and enhanced communication among the different local offices**, so that different requirements do not lead to documents which bind aspects of the project that might be contradictory. On the other hand, **the need to make more data available to support decisions and dissemination of practices** Hence, experiences from environment agencies, practitioners and local offices should be disseminated, and more academic research might be devoted to provide data and support local offices in similar decisions.

This, in turn, supports **the need to enhance research effort into the investigation and dissemination of real processes** and the creation of a "body of knowledge", as put in light in Section 2.3.

Chapter 7

7 Evaluating the performativity of maps

Overview

Chapter 7 deals with the evaluation of the "visual vocabulary" crafted during the present research and used to analyse the case-study presented in Chapter 6. The evaluation is conducted through a focus group with stakeholders involved in the process, on the basis of the *critical proximity* concept presented in Chapter 3.

Section 7.1 presents the set-up and conduction of the meeting.

Section 7.2 presents the results of the meeting, based on content analysis conducted on the recordings of the meeting.

Section 7.3 sums up the contents of the previous section, providing some indications for further development of similar visualizations

7.1 Preparing and conducting an evaluation meeting

7.1.1 Setting up the meeting

As indicated in Chapter 3, the crafting of a new "visual vocabulary" cannot be completed without putting it under test. Following the concept of *critical proximity* (see Section 3.2), in-person discussions with stakeholders directly involved in the process was considered as the best way to evaluate the visualizations.

This kind of evaluation was also supported by the fact that the maps produced in this study where aimed not only at exploring case studies in academic context alone, but also at **testing possible tools which might be refined and used in the daily work of local offices**, in order to provide a higher awareness on the different aspects of a building process, enhancing coordination between different offices and providing a better management of the different tasks.

Therefore, the maps produced on the case study presented in Chapter 6 were put under evaluation through **a focus-group conducted with representatives of different local offices** which were involved in the process.

Three levels of evaluation were defined in order to guide the discussion and the observation of the participants by the researcher during the meeting:

Legibility: Is the chosen visual language understandable? Are the maps readable? Are there some parts which are unclear? How could they be improved?

Accuracy of the maps: Are the maps an accurate representation of the process? Are there some parts which have been neglected or misunderstood?

"Agency" of the map: Do the map show some aspects of the process which some of the involved stakeholders had neglected/didn't know? Do they modify somehow their attitude towards the case-study? Do they enhance a dialogue between the different stakeholders?

A preliminary focus group was run in September 2019 with three colleagues in order to test the setting of the meeting, the questions which may be posed to participants and the presentation modalities of maps. The group was composed by one colleague who had followed my work from the beginning, and therefore knew the case-study and the process through which the maps had been constructed, and two other colleagues who had not been involved in the research and were therefore looking at the maps for the first time.

The meeting was hence also used to have an external evaluation on the completed maps, with respect to their readability, the organization of their layout and the visual language which had been used[154]. The outputs of this meeting served indeed for the final modification of the maps before the focus-group with stakeholders was conducted (see Section 4.4). Both printed maps and projected maps, which could be browsed through the use of Adobe XD[155], were used to present the work and run the discussion.

The setting resulted to be suitable for the meeting and the combined use of printed and interactive maps was judged as best option for the focus group, as it allowed participants to write and discuss on printed maps, while also being guided through them by links on the interactive version.

7.1.2 Running the meeting

The focus group with the stakeholders was conducted in October 2019, involving three participants from the Environment area, the Mobility area and the Urban Planning area of the city of Turin. At the beginning of the meeting, instructions were provided to participants on how the meeting was going to be conducted.

Instructions on the meeting conduction included:

- a hint on the theoretical background within which the work was produced;
- the presentation of the research questions detailed in Section 2.4, in order to explain which were the aims leading the crafting of the maps;

[154] The maps were discussed in the different phases of their production with my supervosprs and with colleagues from the doctoral school. However, in this case, it was the first time in which an evaluation was conducted on finished maps by researcher who saw them as external observers that were not involved in the process before, and could therefore provide a view that was more similar to the one of the stakeholders invited to the focus group.

[155] Adobe XD is a platform for the creation of prototypes of websites and mobile apps. In this case it was used to create a very basic website in which the users could navigate through the instructions on how to read the maps and then through the maps themselves, going from the general map to specific zooms and vice-versa

- the presentation of the three levels of evaluation with respect to which the maps would be examined;
- an explanation of the different typologies of maps that were used (general framework and different detailed investigations, presented in Section 4.3);
- a brief explanation of the structure of each type of map (what could be found in each part of the maps);

Of the three type of detail maps listed in Subsection 4.3.2, only the one focusing on specific concerns and the one focusing on specific actors (policies) through the process were presented. The network visualizations focusing on single moments were evaluated as too complex in the preliminary focus-group with colleagues. They also presented a different layout with respect to the general framework map and to the other maps, and during the preliminary focus group this was evaluated as potentially counter-productive for the meeting. Indeed, they would have required new explanations to the stakeholders, leading to a too long meeting and a too heavy load of material to be evaluated in the meeting, hence compromising the outcomes.

After providing the above-mentioned instructions, participants were asked to use the maps in order to answer to a specific series of questions (namely: when did the controversy on noise mitigation at source emerged? When did it end? Which solutions of mitigation at the receiver were accepted or discarded? Which actors contributed to such decision?). This was used as a "training" phase to give participants a hint to start the engagement with the maps, trying to move through them looking for information and familiarize with them.

Participants were then left free to conduct the discussion and browse through the maps in order to reconstruct the process and discuss it. My intervention as a researcher following the meeting was kept as lower as possible, in order to not influence the discussion. A couple of targeted questions were posed at the end of the meeting in order to better assess the issue of utility of similar maps in discussions between different local offices, which had not been covered during the reconstruction of the process.

7.2 Results and considerations on the meeting

7.2.1 Legibility, Accuracy and Agency of the different maps

In order to evaluate the results of the focus-group, a qualitative content analysis (Kracauer 1952; Cho and Lee 2014) has been performed on the notes taken during the meeting, as well as on recordings of the meeting.

The analysis was structured on the basis of the three levels listed in Subsection 7.1.1. For each of the 3 levels, sub-levels have been inductively identified while performing the analysis. The coding is therefore derived from both deductive and inductive definition (Cho and Lee 2014)[156]. Moreover, the material has also been

[156] As put in light by Elo and Kyngas (Elo and Kyngäs 2008)qualitative content analysis is flexible to the use of both deductive and inductive categories for data analysis, on the basis of the research purpose

coded with respect to the map or the specific section of a map that was being discussed.

Table 7.1 reports the codes used for the analysis. The first column on the left identifies the main category, the second columns reports the identified sub-categories, while the third column provides a brief description of each subcategory.

Table 7-1–Categories and sub-categories for the qualitative content analysis

Levels of analysis		
Category	**Sub-category**	**Definition**
Legibility	Legibility_positive	The participants have correctly read a part of the map and/or have made explicit comments on its legibility (e.g.”this part is clear”)
	Legibility_negative	The participants have misread a part of the map, have not managed to read the content or have made explicit comments on the difficulty to read it.
	Legibility_missing elements	The participants have commented on specific elements that they would have added in the map to improve its readability and the information that can be gathered from it.
Accuracy	Accuracy_negative	The participants have put in light some errors in the maps
	Accuracy_positive	The participants have confirmed that the map or a part of it correctly represent what happened in the process
Agency	Agency_new perspective	The participants got to see something they hadn’t realize or didn’t know about the process (either explicitly declaring it or showing it through their interaction)
	Agency_interaction	The participants engaged in a discussion between them, starting from a part of the map. (e.g. one participant explains to another a policy, moment of the process, etc)
	Agency_future	The participants discuss about the possibilities of using similar maps in the future
Parts of the maps		
Category	**Sub-category**	**Definition**
General map	General map	The discussion is referred to the general map as a whole
	General map_documents	The discussion is referred to the area of the general map where the documents are represented
	General map_concerns	The discussion is referred to the area of the general map where concerns are represented
	General map_effects	The discussion is referred to the area of the general map where effects on the project are represented
	General map_phases	The discussion is referred to the area of the general map where the different phases of the process are indicated.
Concern maps	Concern maps	The discussion is referred to one of the “concern” maps as a whole

	Concern maps_solutions	The discussion is referred to the area of the "concern" maps in which solutions are listed
	Concern maps_effects	The discussion is referred to the area of the "concern" maps in which effects are represented
	Concern maps_non-human actors	The discussion is referred to the area of the "concern" maps in which non-human actors are represented
Policies maps	_	The discussion is referred to one or more of the "policies" maps
Maps	_	The discussion is referred to all the presented maps, as a whole
Connections/browsing	_	The discussion is referred to reading through a map and/or to the connection between different maps.

Outcomes of the content analysis were then analysed through a code **co-occurrence analysis between** the codes that identified **parts of the maps** and the codes that identified **the levels of analysis**, reported in Table 7.1. In this way it is possible to see which parts of the maps were discussed more in the meeting, which parts gave positive or negative results with respect to legibility and accuracy of the representation, and which ones exerted an agency on the discussion between participants and their awareness of the examined process.

Table 7.2 reports the results of the analysis with respect to legibility, accuracy and agency of the maps. The numbers in the table indicates the number of times in which a certain part of the map (listed in the rows) was discussed in relation to one of the levels of analysis (listed in the columns).

For instance, by looking at the first group of rows in the table ("general map" category), it can be seen that comments emerged during the meeting on the whole map, as well as on the concerns, documents and effects section and on its division in different phases of the project (second column of the table). Going deeper into the exploration of the table, by following one of the rows it can be seen that, for instance, the "concerns" section of the general map (General map_concerns, fourts row of the table) was commented one time during the focus group to put in light some missing elements that could improve legibility and five times with comments that put in light positive outcomes on its legibility. Moreover, one time during the focus group was put in light a negative element in its accuracy. With respect to agency of the maps, for two times the agency of the "concerns" section of the general map emerged in relation to enhancement of new perspective and understanding of the process for one or more of the involved stakeholders, while for four times it resulted to enhance interaction between the stakeholders and one time was discussed in relation to the possibility of using similar maps in the future.

Table 7-2–.results of the co-occurrence analysis between codes related to parts of the map (rows) and to levels of analysis (columns).

		Legibility			Accuracy		Agency		
		Missing elements	Legibility_ negati	Legibility_ positiv	Accuracy_ negative	Accuracy_ positive	Agency_ new perspective	Agency_ interaction	Agency_ future
General map	General map		1						1
	General map_concerns	1		5	1		2	4	1
	General map_documents	3		1		1	3	1	
	General map_effects			3			1		
	General map_phases	1		2			4	1	
Concern maps	Concern map_solutions		1	4			2		
	Concern maps_effects		1				2		
	Concern maps_ non human actors			1		1			
	Concerns map					1	2	2	
Policies map	-		1	1	1		1		
Maps	-							1	1
Connections/ browsing	-		1	1					1

7.2.2 Outcomes from the general framework map

By looking at the results in Table 7.2, it can be inferred that the general framework map was the more discussed one during the meeting. Positive feedbacks on the legibility of its different parts were several more than negative ones (just one comment in general on the map). The agency of the general map emerged also quite well in the discussion. This was evident in particular with respect to new perspectives provided on the process. Nevertheless, also interactions between participants emerged, in particular with respect to the "concerns" part of the general map, and a couple of hints on possible future developments. It could therefore be said that, in general, the layout designed for the general map received positive response from the participants to the focus group and managed to have an agency, enhancing new perspectives on the process as well as interaction between stakeholders. This put in light that, despite some missing elements indicated by the participants, which should be integrated to improve legibility, the designed map can be considered as a good starting point for representation of processes in similar studies.

Figure 7.1 and 7.2 provides a more in-depth view on some of the results on the general map. In this phase, other codes were added to the analysis to briefly indicate more precisely the subject discussed in the different quotations extracted in the previous coding phase. In particular, Figure 7.1 focuses on the missing elements pointed out by the participants in terms of legibility of the maps, while Figure 7.4 explores more in detail the agency of the map. In the visualizations, the parts of the maps are indicated in grey labels, while the codes related to the themes of discussions are marked in pink. The white rectangles report the quotations[157].

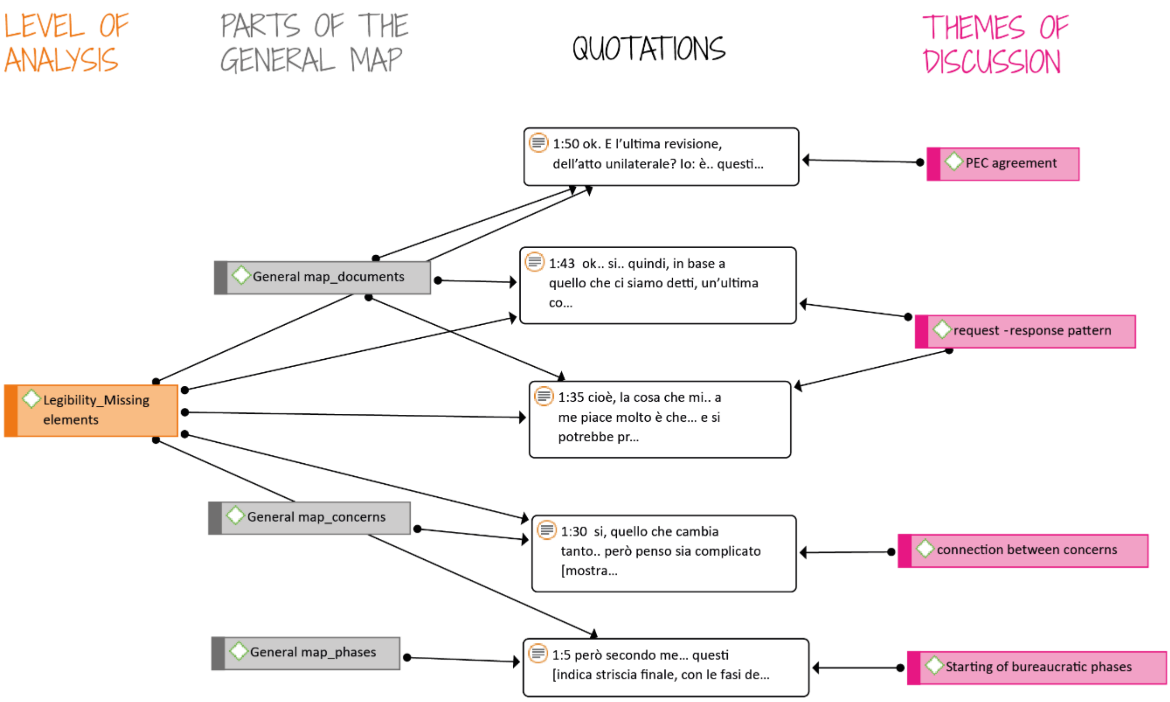
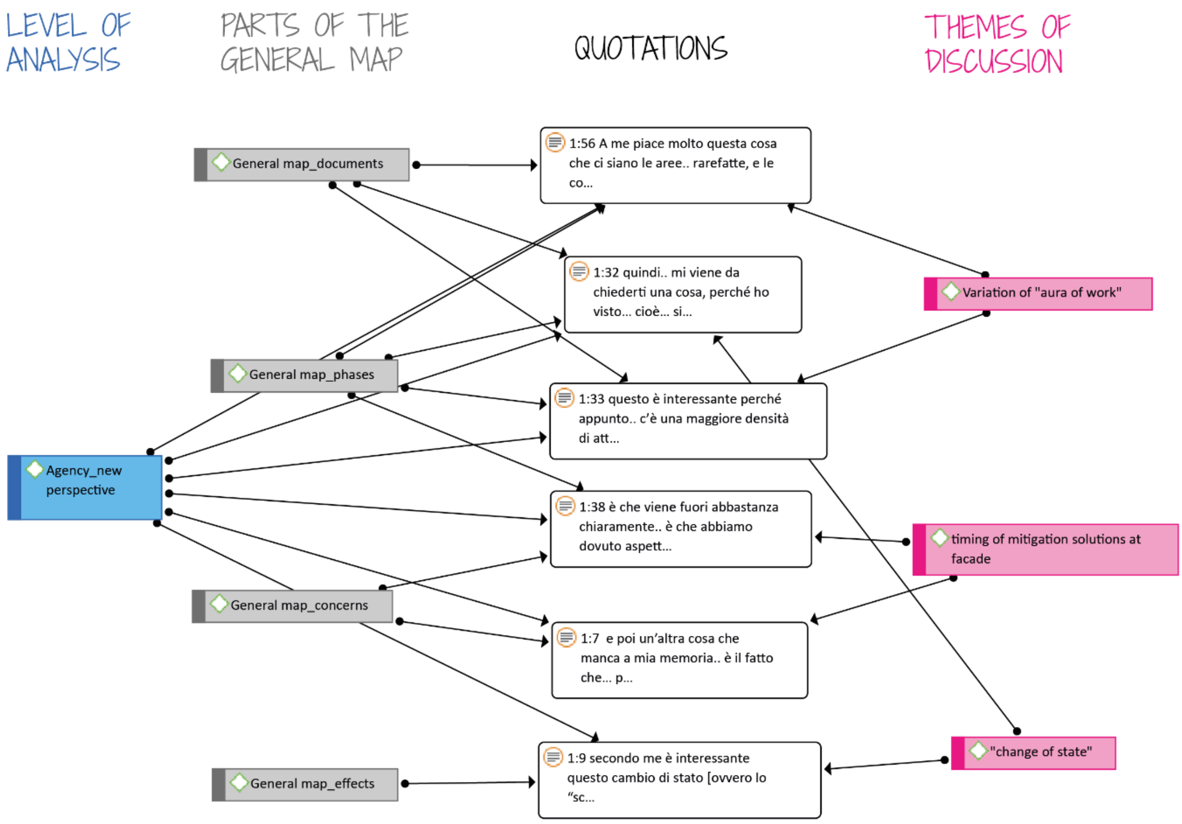
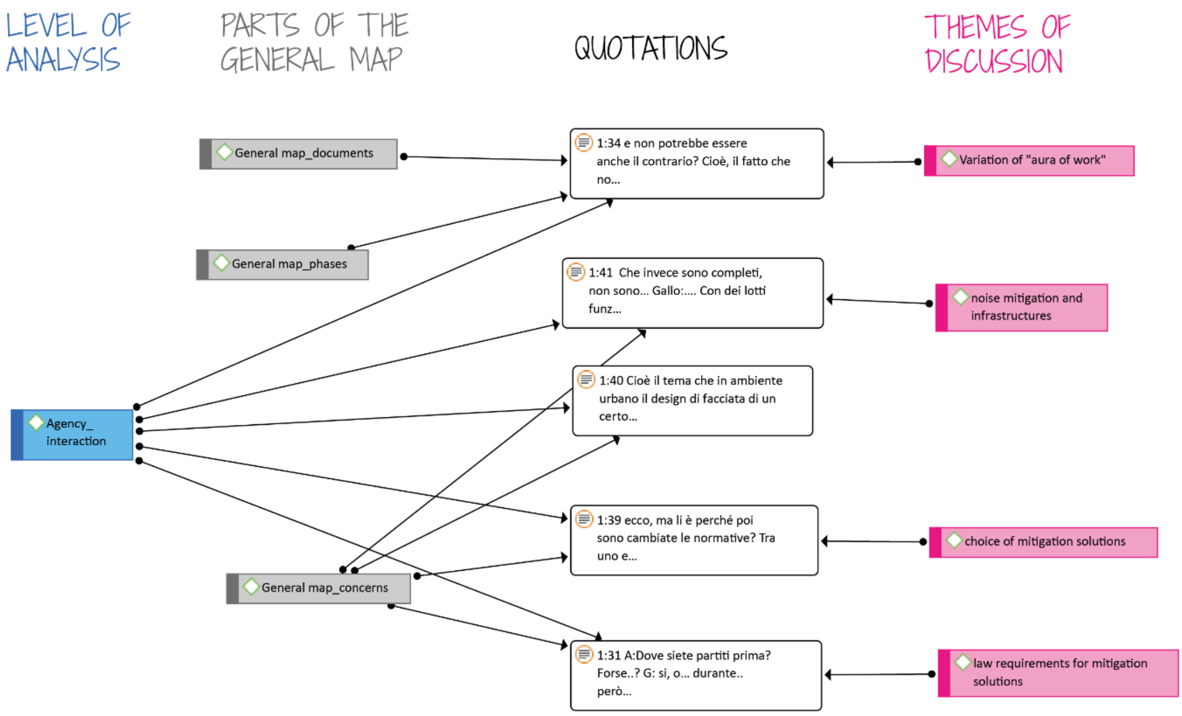


Figure 7.1– In-depth analysis of the parts of the discussion in which missing elements were highlighted in the general map

[157] Quotations are in Italian, since the focus group was conducted in italian.


LEVEL OF ANALYSIS
PARTS OF THE GENERAL MAP
QUOTATIONS
THEMES OF DISCUSSION
General map_documents
1:56 A me piace molto questa cosa che ci siano le aree.. rarefatte, e le co...
1:32 quindi.. mi viene da chiederti una cosa, perché ho visto... cioè... si...
Variation of "aura of work"
General map_phases
1:33 questo è interessante perché appunto.. c'è una maggiore densità di att...
Agency_new perspective
1:38 è che viene fuori abbastanza chiaramente.. è che abbiamo dovuto aspett...
timing of mitigation solutions at facade
General map_concerns
1:7 e poi un'altra cosa che manca a mia memoria.. è il fatto che... p...
1:9 secondo me è interessante questo cambio di stato [ovvero lo "sc...
"change of state"
General map_effects


LEVEL OF ANALYSIS
PARTS OF THE GENERAL MAP
QUOTATIONS
THEMES OF DISCUSSION
General map_documents
1:34 e non potrebbe essere anche il contrario? Cioè, il fatto che no...
Variation of "aura of work"
General map_phases
1:41 Che invece sono completi, non sono... Gallo:.... Con dei lotti funz...
noise mitigation and infrastructures
1:40 Cioè il tema che in ambiente urbano il design di facciata di un certo...
Agency_ interaction
1:39 ecco, ma lì è perché poi sono cambiate le normative? Tra uno e...
choice of mitigation solutions
General map_concerns
1:31 A:Dove siete partiti prima? Forse..? G: sì, o... durante.. però...
law requirements for mitigation solutions

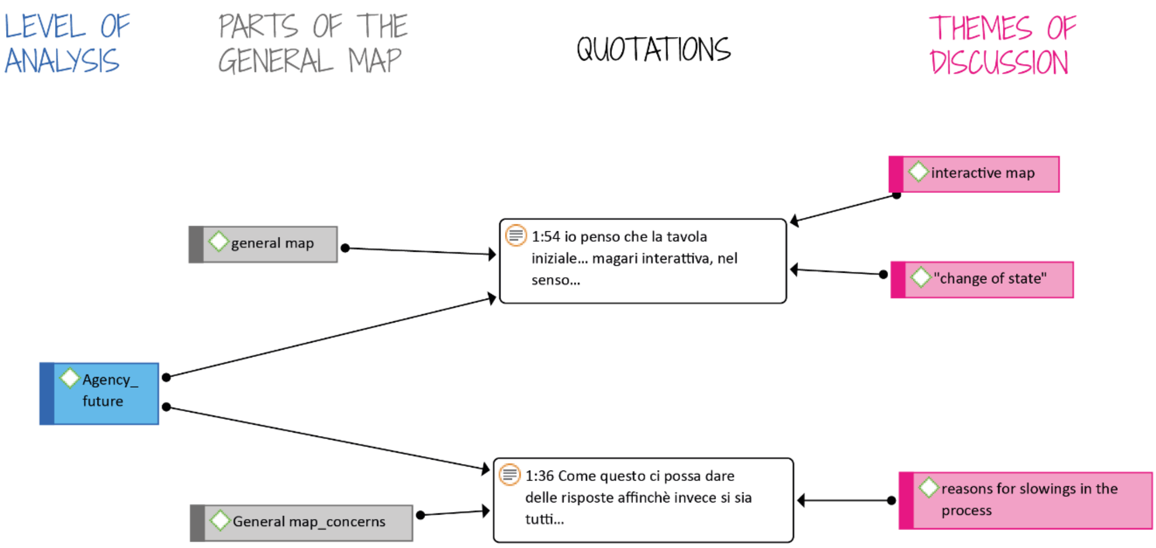


Figure 7.2– in-depth analysis of the parts of the discussion in which the different aspects of the maps agency (namely, new perspective, interactions between stakeholders and consideration on future uses and developments) were highlighted in the general map

Looking at Figure 7.1, it can be seen how the missing elements were mainly the request to **visualize connections between different concerns**, to show how one of them led to the other (for instance, how the concern on mitigation solutions at the façade led to the concern on testing methods) **and the connections between documents**, in order to clarify the request-response pattern within the cloud of documents, and to use the slope of such connections to visualize the time-span between one request and the relative response.

In Figure 7.2a it is shown how the **new perspective on the process** highlighted by the participants while looking at the maps were **the visualization of the "aura of work" needed to lead to the closure of a certain phase (i.e. the cloud of documents)** and its variations between empty areas and crowded areas in the urgencies of the granting of a permit **and the "change of state", i.e. the visualization of material effects of mitigation requirements on the project**. Moreover, new awareness came from one of the participants on the timing with which the mitigation solutions at façade were discussed with respect to the process phases (i.e. only at the phase of building permit granting and not before).

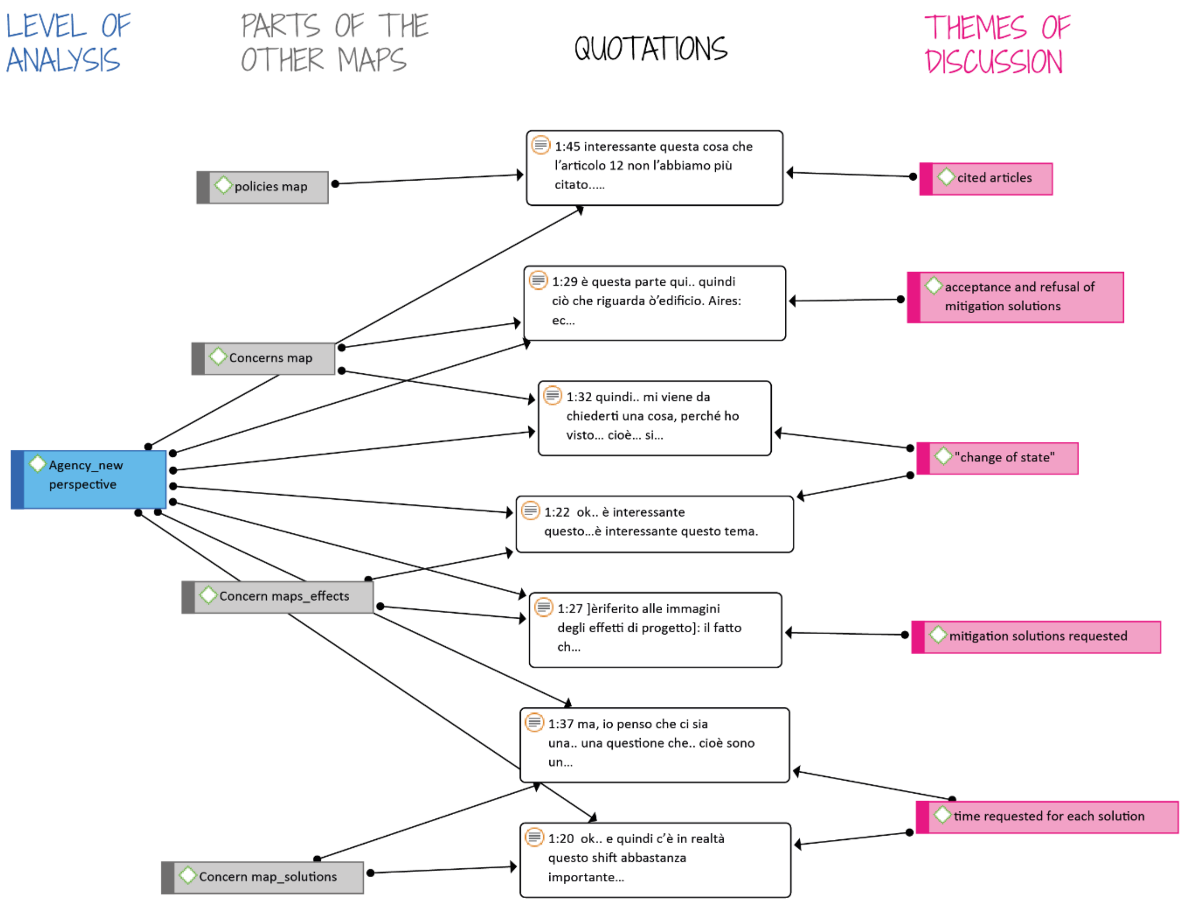
Moreover, in Figure 7.2b it is shown how **the maps enhanced discussions between the participants** expecially with respect to the reasons between the choice of different mitigation solutions and the law requirements on this aspect, as well as on the issue of coordinating the mitigation measures with the infrastructure design and realization. In this case, **a "seeing through" frameworks of interpretation of the different local offices is therefore witnessed,** in which participants showed interests in understanding more deeply the processes and law requirements to which the other offices are subjected. Finally, in Figure 7.2c it can be seen how the discussion on possible future developments put in light that **the visualization of material effects on the project in connection to the different concerns**, as well as of the **activation and "pause" of different concerns through the process** could, in the view of the participants, **enhance awareness on the processes and discussion between local offices**. Moreover, they also highlighted **how interactive maps could facilitate the legibility and the use of them.**

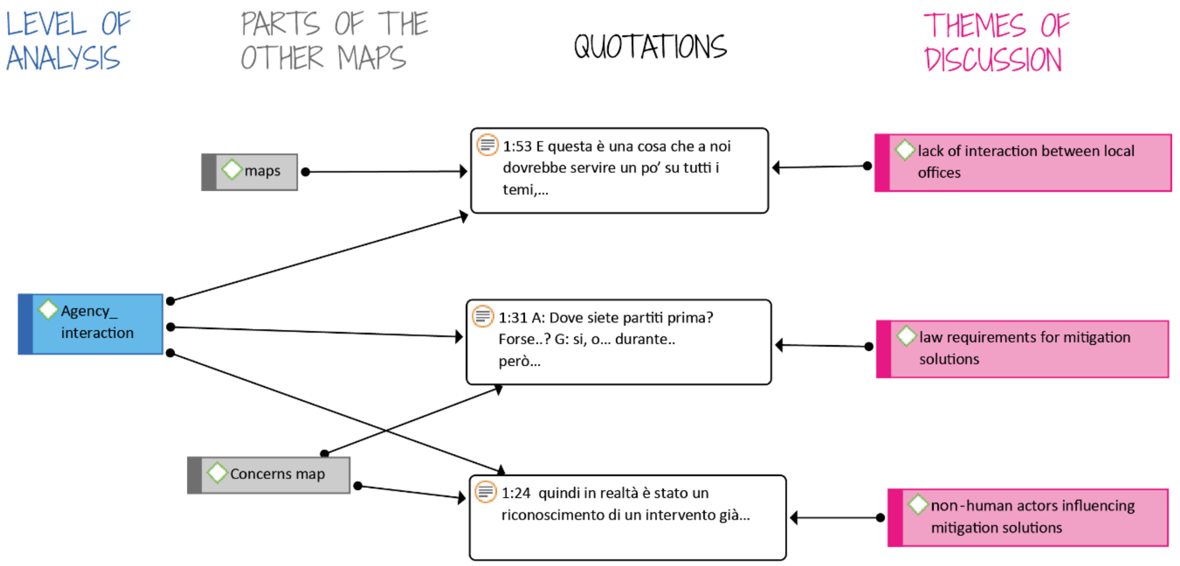
7.2.3 Outcomes from the other maps

By looking at the second part of Table 7.2, it can be seen **that also the maps zooming on the different concerns received in general positive feedbacks with respects to legibility and accuracy**, while some issues were put in light for the maps focusing on policies and for the connections between different maps.

In particular, the issues of legibility were due, in the concern maps, to the alignment of the figures visualizing the different material changes of the project (see Figure 6.12) and, for one of the participants, for the use of symbols to indicate the proposal, acceptance or refusal of different solutions. In the policies map, instead, another one of the participants showed difficulties in reading the involvement of different policies in time. Finally, the presentation of the maps as completed and static drawings, in which the information were presented all together, was indicated by the participants as a complication in the understanding of maps, while **the use of interactive maps to select and filter information was suggested.**

Figure 7.3 shows a more in-depth view on the agency of the maps. As in Figure 7.1 and 7.2, the parts of maps are indicated with grey labels, while the additional codes to synthesize the themes of discussion are indicated with pink labels.


LEVEL OF ANALYSIS
PARTS OF THE OTHER MAPS
QUOTATIONS
THEMES OF DISCUSSION
policies map
1:45 interessante questa cosa che l'articolo 12 non l'abbiamo più citato.....
cited articles
1:29 è questa parte qui.. quindi ciò che riguarda ò'edificio. Aires: ec...
acceptance and refusal of mitigation solutions
Concerns map
1:32 quindi.. mi viene da chiederti una cosa, perché ho visto... cioè... si...
"change of state"
Agency_new perspective
1:22 ok.. è interessante questo...è interessante questo tema.
Concern maps_effects
1:27]èriferito alle immagini degli effetti di progetto]: il fatto ch...
mitigation solutions requested
1:37 ma, io penso che ci sia una.. una questione che.. cioè sono un...
time requested for each solution
1:20 ok.. e quindi c'è in realtà questo shift abbastanza importante...
Concern map_solutions


LEVEL OF ANALYSIS
PARTS OF THE OTHER MAPS
QUOTATIONS
THEMES OF DISCUSSION
maps
1:53 E questa è una cosa che a noi dovrebbe servire un po' su tutti i temi,...
lack of interaction between local offices
Agency_ interaction
1:31 A: Dove siete partiti prima? Forse..? G: si, o... durante.. però...
law requirements for mitigation solutions
Concerns map
1:24 quindi in realtà è stato un riconoscimento di un intervento già...
non-human actors influencing mitigation solutions

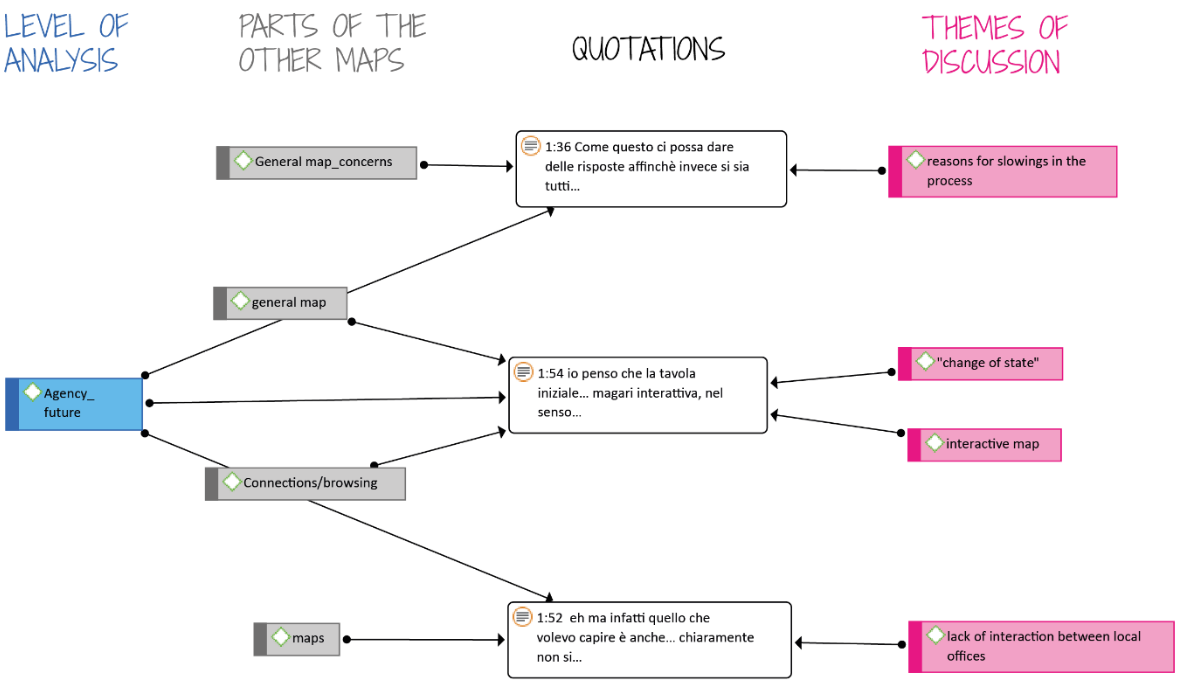


Figure 7.3– in-depth analysis of the parts of the discussion in which the different aspects of the maps agency (namely, new perspective, interactions between stakeholders and consideration on future uses and developments) were highlighted in the concern maps, policy maps and with respect to the maps in general and the connections between them.

By looking at the maps in Figure 7.3, it can be seen that *the new perspective on the process* (Figure 7.3a) **were provided essentially by the concern maps, in particular the ones related to the concerns of mitigation solutions at source and at receiver**. Indeed, the maps made visible the number of solutions which were discussed during the process, the amount of solutions which had to be discarded and the time-span that each solution required in order to be implemented. In particular, the awareness that no solutions at building façade were implemented and of the time needed to reach an agreement on the portal with messages for speed reduction **stimulated the discussion between stakeholders on possible mitigation solutions in similar cases**. **The connection of material effects with the evolution of the concern was again appreciated**, in particular the fact that it made clearly visible the impact that the acceptance of every solution had on the project.

The discussion between participants generated by the concern maps (Figure 7.3b) leaded to clarifications between them on the non-human actors which interacted with the acceptance or discarding of different solutions, in particular with respect to mitigation solution at source, which of course need to be coordinated with the infrastructure project. Moreover, clarifications between the participants on the law requirements in terms of mitigation solutions took also place during the meeting.

Moreover, although the policies maps were less discussed, in one case they leaded to new awareness in the Environment area on how references to the local Acoustic classification plan were used in their responses.

Finally, with respect to future implementations of the map, the connection of the discussed solutions with material effects on the process was again underlined as a useful tool, while also the visualization of the evolution of concerns in time, with "pauses" and reactivations in time, was indicated as an element that could enhance interactions between local offices. The use of interactive maps was again suggested.

7.3 Summing up: conclusions and indications for future visualizations

This chapter presented the evaluation of the visualizations crafted in the present research (see Chapter 6), by means of a focus group with some of the stakeholders involved in the process, namely one representative of the local Environment Area, one representative of the local Urban planning Area and one of the local Mobility Area.

This type of **evaluation is based on the concept of *critical proximity*** expressed by Bruno Latour (see Chapter 3) and was evaluated as the more convenient also because the aim of the visualization realized in this research is not only to investigate the selected process from an academic point of view, but also **to work as possible tools for discussions and exchange between local offices on similar processes in the future.**

The focus group was firstly prepared through the definition of three levels under which the maps had to be evaluated (namely, the legibility of maps, they accuracy in reproducing the process and their agency in enhancing new awareness on the process in the involved stakeholders and new discussions and interactions between them and on possible future implementations of the map).

Moreover, a test meeting was held with three colleagues in order to test the meeting settings and the modalities of presentation of the maps.

The focus group was held in October 2019. During the meeting, participants were given initial instruction on the aim of the work and on how to read the maps presented to them. After a "training" phase on the reading of maps, they were left free to discuss the maps and browse through them as they wanted in order to reconstruct and discuss the process, while the researcher observed and recorded the discussion.

The material collected during the focus group was then analysed through a qualitative content analysis, looking for the parts of the maps which were discussed and how the three levels of analysis (legibility, accuracy, agency) emerged in the discussion in relation to the different parts of the maps.

Result of this analysis showed that the **general framework map had positive feedbacks in legibility and that its agency emerged** quite well during the discussion. This put in light that, despite some missing elements indicated by the participants, which should be integrated to improve legibility, the designed map can be **considered as a good starting point** for representation of processes in similar studies.

Moreover, **the concern maps also had quite positive feedbacks in terms of legibility and showed a certain agency** in enhancing new perspective on the process and interactions and clarifications between stakeholders. The policy maps and the connection between them were less discussed in the meeting. However, in one case the policy map enhanced new awareness on how the local noise policies were used as references in responses of the Environment area, while some suggestions on future implementations of the maps emerged, in terms of browsing and connections between maps.

In particular, **the following indication could be derived** for further use and implementation of the maps:

The visualization of the "cloud of documents" in the general framework map was particularly appreciated by the participant to the focus group, as it allowed to see how the production of documents moved through successive "waves" under the urgencies of acceptance and granting of specific documents.

Lines connecting the acoustic environment reports and the related responses from the local offices were requested as **additional visual elements, in order to picture the path of the discussion** and use the slope of such lines as a visual metric for the time-span occurred between one report and the related response.

The **visualization of time-span of the different concerns with respect to the phases of the process** (from masterplan variation approval to granting of the building permit) was reported to **enhance awareness** on how a certain topic of discussion was brought up, and was **indicated as useful for possible future discussions between local offices**.

The **visualization of material effects in relation to the different matter of concern was also appreciated by the stakeholders and indicated as useful for possible future discussions between local offices**. It was judged as particular effective within the "concern" maps, in which it is possible to see the **direct connection between the choice of each mitigation solutions and its material effects** on the project.

In the "concern" maps, **the visualization of the list of all the proposed mitigation solutions,** together with the indication on the timeline of when they were proposed, accepted or discarded, **had an agency in enhancing exchanges between stakeholders and new awareness** on the topic, hence is should be kept in future development of similar maps.

A need of more interactive maps was brought up by the participants, as they express the need to see the information more gradually and not all together in a static map, although divided in different zooms.

As a general conclusion, **the maps emerged therefore as a valuable first step** on which to build on future developments of similar visualizations, as they in general showed good legibility and agency in enhancing awareness on the process within involved stakeholders and interactions and clarifications between them. Further developments of the maps should however work more on digital interactive designs.

This last indication, brought out by participants during the focus group, confirmed through direct experience what suggested by Venturini *et al.,* who underlined how “datasape navigation” is crucial for an effective use and evaluation of such visualizations, as it allows the observer to follow the logic path provided by the researcher through the controversy, but also to further explore the complexity, by even going back up to raw data (Venturini et al. 2015).

Such combination of narration and exploration is crucial to leave the visualizations open for future improvements and developments of the maps (“design after design”) that, as suggested by the authors, should imply a cyclical processes of crafting tools and submitting it to the public, in “a spiral in which every coil delivers better maps and engages larger publics”.

Since, as briefly seen in Chapter 3, the situated evaluaton of maps is based on a pragmatist concept of “public”, each new evaluation of maps by the public requires a careful design of the public itself, on the basis of the actors involved in the controversy.

This brings out the necessity to provide a brief reflection, in conclusion of the chapter, on such concept of public in relation to the specific issue investigated in this thesis and to its possible future developments.

As previously said in this chapter, the maps have been put under test with representatives of the public local offices that were directly involved in the controversy, as the maps were primarily conceived for future uses in such contexts.

Drawing from Venturini *et al.,* they could be considered as the “alpha-users” (Venturini et al. 2015) who were involved in the first step of maps evaluation.

Following the view of public as “the assemblage of the actors involved in the debate” (Venturini et al. 2015) presented in Chapter 3 (see Subsection 3.2.2), other publics with which to envision following “cicles” of evaluation and desing of the maps should be the practitioners involved in it (architects, acoustic consultants and developers). However, the pragmatist vision also speaks of the public as those who are “affected by” a certain controversy (Dewey 2016). In this case, future inhabitants of the two case studies were not directly involved and affected during the investigated project, as the work focused on the design phases of the buildings. The investigation of their involvement was therefore out of the scope of this work, whose aim whas to focus on “traditional” building processes, normally developed within local offices an practitioners studios. However, they would be of course ultimately affected by the choices taken during this phase, as they will inhabit the results of such choices.

Therefore, possible future developments of the work, while placing the specific controversy within a broader view of “meta controversies” to which it is connected (Venturini et al. 2015) may take into account the position and view of inhabitants, while investigating the following phases of the bulding life or either focusing on processes of participatory design in noise polluted areas.

This may give other important directions for policies and practices in the field, as previous studies applying a similar perspective on pulic involvement in environmental quality and noise in cities have pointed out how it can affect debate and outcomes.

A recent work by Offenhuber and Auinger (Offenhuber and Auinger 2019) pointed out how noise sensing and monitoring is not a black box and how participatory sensing, emerging thanks to ubiquitous technologies in contemporary cities, are challenging the traditional practice of noise measuring and mapping. In connection with soundscape studies, participatory sensing often accounts for other metrics apart from loudness and frequency. By involving the public, participatory sensing generates controversy on what should be measured and how, showing that noise exposure assessing and reporting, just like other environmental issues, is deeply intertwined and influenced by concerns on health, aesthetic norms and social issues such as neighbourhood perception and concerns for property values. Nold (Nold 2017) showed such issues in real case-studies, through ethnographic observations and device design, underlying how the ontological conception of noise was at the core of controversy rasing on participatory sensing devices and a key to design a device, together with its users, to stage a multiplicity of annoyances, hence developing new metrics that might challenge noise exposure verifications and its outcomes.

Such considerations frame the work presented in this thesis within much wider controversies which were beyond the aim of this work. Nevertheless, since we have seen that policies are complex sociotechnical objects that also in the past have been pushed by public opinion and perception of noise exposure issue (see Chapter 1), a development of the work that aims ultimately at improving noise policies and their integration in architectural design should take into account such aspects that are also challenging actual policies.

PART III

Chapter 8

8 Noise regulations in the Netherlands

Overview

Chapter 8 presents the normative framework which is involved in urban transformations in the Netherlands with respect to noise mitigation issues.

Section 8.1 presents the Dutch national legislations in terms of noise abatement requirements.

Section 8.2 focuses on the requirements set by local authorities and on the differences between local policies and guidelines, focusing especially on the city of Utrecht, in which the case-study investigated in the following chapter is located.

Section 8.3 sums up what presented in the previous sections, summarising the normative requirements at national, regional and local level regarding noise mitigation fulfilments in urban transformations.

8.1 National Dutch legislation

8.1.1 The Dutch Noise Abatement act and the noise limit levels

As mentioned in the introduction, the Part III of the thesis focuses on the application of the crafted "visual vocabulary" on a foreign case-study. The Netherlands have been chosen for this study since they are seen by the city of Turin as an example to compare with when assessing noise mitigation in urban transformations, especially with respect to noise mitigation at dwelling façade. Indeed, in the Netherlands the issue is tackled in the legislation since the Eighties, when the national Noise Abatement act[158] came into force[159].

The act generated from the awareness that regional and urban planning constitute powerful instruments in preventing exposure to noise pollution. The increasing concern raising after the Second World War on the effect of noise pollution on public health had already led to the Aviation Act in 1958, assessing the

[158] *Wet Geluidhinder*

[159] As done in Chapter 5, here only the legislative aspects which are of interest for the realization of dwellings in noise-polluted areas will be presented. For a more comprehensive analysis see specific literature on the analysis of noise legislation in the Netherlands (e.g. (Weber 2013; de Roo 2003)) and/or the texts of the mentioned laws.

issue of fitting an expanding airport within residential developments. However, studies of the following years showed how high percentages of inhabitants were regularly annoyed by other noise sources, such as traffic noise (Weber 2013).

In 1968 the Dutch government required therefore to the national Health Council to provide advices on measures to abate noise, in order to preserve public health, as part of a general growing awareness on environmental problems and their impact on health. Among the advices provided by the Health Council, in a report issued in 1971[160] there was the proposition of a comprehensive law tackling noise abatement (de Ruiter 2004).

Upon this suggestion, thanks also to the establishment in 1972 of the Ministry of Public Health and Environment (Weber 2013), the Dutch government sent to the Parliament a preliminary version of the first national **Noise Abatement act** in 1975 (Bijsterveld 2003). The act included regulations against different environmental noise sources such as industrial noise, rail and road traffic, leisure noise.

As reported by (Weber 2013), Dutch noise policies are based on three pillars which were defined at the time by the central government, namely "(i) prevention of noise pollution; (ii) solution of existing problems of noise pollution; and (iii) reduction of noise emissions from traffic and other sources".

Prevention of the creation of new noise pollution, i.e. a higher number of sensitive receivers exposed to high noise values, was tackled by the Noise Abatement act through the instrument of **spatial zoning, in order to separate noise sources from noise sensitive areas**. Therefore, criteria for the establishing of **buffer noise zones around roads, railways and industries** were set in the act. Moreover, two other pillars of the noise policy were the insulation of existing dwellings exposed to high noise levels and reduction of noise emission from vehicles.

As pointed out by De Ruiter[161]:

*"The main point of this law is **that noise control can be integrated into physical planning**. And that's a very, very important step. Because the most nasty problem arrives if.. expecially dwellings are too near [to] roads, or and industries, etcetera. [...] this fits into a long history of physical planning in the Netherlands as such... I think it has to so with the fact that we hardly have any natural barrier, than almost every place in the Netherlands we give the function we like. [...] And the noise abatement act was built upon this structure, of already having, well... physical planning, zoning plans. So it was decided that part of zoning plans would be noise zones".*

The trust in the "technological fit" that leaded the years of entering into force of the act was then followed by a period that proved the noise problem to be far more complex and persistent, leading to a series of adjustment in the government goals and in the policy itself, moving generally towards less strict goals and more

[160] "Rapport Gezondheidsraad commissie geluidhinder en lawaaibestrijding"

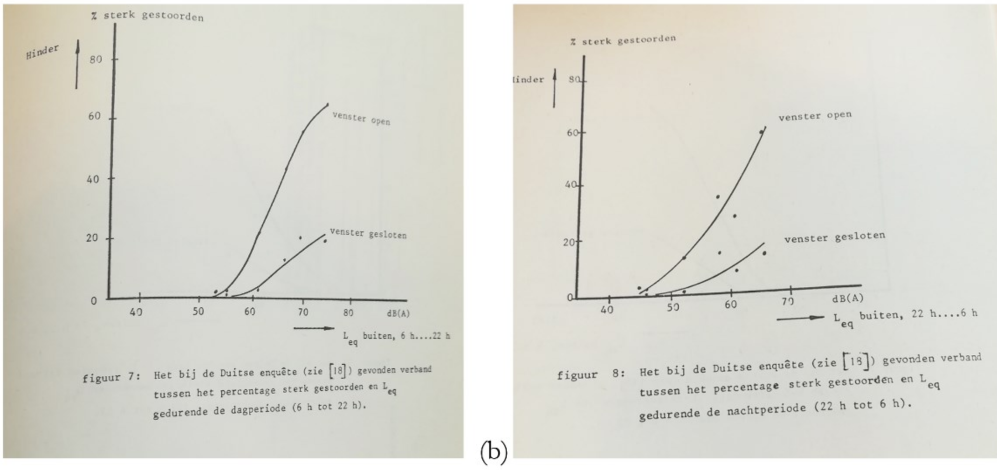
[161] Interview conducted on 1st November 2018

decentralized tackling of the problem, giving more freedom to local authorities in implementing the requirements of the act (Weber 2013)[162].

In its actual configuration, the Noise Abatement act, given the impossibility to integrate the land development with the ideal goal to keep all noise-sensitive receivers out of the noise zones associated to roads, railways and industries, sets **two different kind of limit values that should be respected for noise-sensitive receivers,** ad in particular for dwellings. The regulation is based on dose-effect relationship to noise annoyance for various noise sources. The preferred noise standard to be respected is the one at which a low level of annoyance will occur, i.e. when an acceptable percentage of population would perceive a certain annoyance (see Figure 8.1).

However, also a maximum limit value, that should not be exceeded in any case, is set in the act. According to (Weber 2013) "limit values reflect many other (political, societal) dossiers and considerations as well; transposing thresholds one to one into regulative limit values would heavily impede spatial planning, mobility and economy". Hence, while the preferred noise level is related to noise annoyance, the maximum level is the result of a process of negotiation and prioritization assessment within different requirements of a densely populated country.

Figure 8.1 shows two chart relating noise level with perceived annoyance, as reported in the report of the "Research programme interdepartmental committee on noise annoyance"[163], one of the many reports which were produced contextually with the entering into force of the Noise Abatement act[164].



(a) (b)

Figure 8.1– Noise level-percentage of annoyed people charts in the "Research programme interdepartmental committee on noise annoyance", derived from (a) (Rucker 1975) (b) (Webster and Klumpp 1963).

It can be seen form the charts how in both studies that the 50 dB(A) level corresponds to an average of 3-5% of annoyed population, which, according to

[162] For a broader explanation of this process see (Weber 2013)

[163] In the original: *Onderzoekprogramma interdepartmentale commissie geluidhinder*

[164] Guided consultation of the report was provided by de Ruiter during the interview conducted on 1st November 2018.

literature, is the minimum level of annoyed people that would always be found for any kind of survey. Therefore, the 50 dB(A) level was then indicated as a preferred limit value.

A **set of different noise limits was then defined through different implementing decrees** and their successive amendments and addenda, for different noise sources in different locations (in particular, roads within urban areas or in rural areas, i.e. urban roads and motorways). Figure 8.2 reports the evolution of required noise limits from 1990 to 2007 (Weber 2013). As can be seen from the figure, only one level is reported for each cell of the table. Differently from the Italian regulation, indeed, the Dutch one does not distinguish between daytime and night time limit value for dwellings, but uses a 24-hours noise level. Moreover, it is shown how during the nineties, different limit values have been added especially for re-building areas and transformations that falls within the seaport areas, in order to find a balance between noise protection and the need to anyway redevelop those areas[165]. The change of limits in 2007, on the contrary, is only due to the fact that the 24-hours Dutch levels are substituted with the 24-hours levels defined by the European Environmental Noise Directive (L_{den})[166], which is computed in a different way. The same acoustic environment provides a L_{den} which is about 2 dB lower than the Dutch 24-hours value, hence a noise limit of, said, 50 dB(A) of 24-hours Dutch level in 1990 is the same as a limit of 48 dB(A) L_{den} in 2007. However, a more **important modification** was brought by the amendment of Noise Abatement law **in 2007**, namely the **possibility for local administrations to define their own requirements** in terms of preferred limit levels and requirements for the granting of a higher values exemption (see Subsection 8.1.2 and 8.2.1).

[165] As reported by Weber (Weber 2013), The Second National Environmental Policy Plan issued in 1993 by the Ducth Ministry of Publich Health and Environment referred to the "compact city dilemma" and advocated for area-specific differentiation of existing standards, in order to try to solve the dilemma.

[166] For more in-deep explanation of the differences between the two 24-hours value, see the definitions provided in the European Noise Directive and in the Noise Abatement Act.

Noise limits and changes from 1990 - 2010

	Industries (in LAeq)				Highways and major roads			Municipal roads			Railway traffic		Aircraft (in Ke)	
	Preferred	Maximum	Rebuilding	Sea port	Preferred	Maximum	Rebuilding	Preferred	Maximum	Rebuilding	Preferred	Maximum	Non restricted zone	Restricted zone
1990	50	55			50	55		50	60/65	(70)	60	73	20	35
1993			65	60						70				
1998							60/65							
2000											57	70		
2007					48	53	58/63	48	58/63	68	55	68		
2008													20	35 Ke / 47 Bkl
2009													48	56

Figure 8.2 – preferred and maximum noise levels for different sound sources and their evolution from 1990 (Weber 2013).

In Figure 8.2 it is visible how, while preferred limits are the same for both local roads and highways, in the case of maximum limit for the highway is set a value which is up to 10 dB lower than for the local roads.

As explained by de Ruiter[167]:

"that comes from the difference in the approach of roads within cities and roads in more rural areas. The idea of the law was that if you have a road in a rural area, than you should keep more distance. And in most cases there are also opportunities to place screens and things like that, and well that is.. it was also discouraged in this way to plan neighbourhoods in the area of highways, yes.. but now highways are within the city too and they are still regarded as rural roads. And, so.. highways within city limits can give problems with the law, because the maximum value is rather low."

Moreover, expectations to have more silent vehicles in the future, due to technological improvement, led to the insertion, in the Noise Abatement act, of the possibility to deduce a certain amount of dB for noise levels calculated for new buildings placed in the acoustic zone of roads. The act allows for a maximum deduction of 5 dB deduction for local roads.

Further specifications then led to the definition of a 2 to 4 dB exemption for highways, on the basis of the measured noise level (a deduction of up to 4 dB is allowed when the noise level is 57 dB(A), while from 58 dB(A) onward, only the deduction of 2 dB(A) is allowed, hence leading to an exceedance of the maximum value)[168]

[167] Interview conducted on 1st November 2018

[168] *Reken- en meetvoorschrift geluid* 2012

According to de Ruiter, this difference is partially due to the way in which noise generation in vehicles changes as the speed increases, as at lower speeds the engine noise prevails, while at higher speeds the tire noise, which is more difficult to contain, is predominant, but the insertion of such deduction was also "A very good political move" to allow for higher noise values before the state or the province are forced to pay for mitigation measures for new roads[169].

As further explained by another acoustic consultant[170], the variable deduction for highways is part as well of the modifications introduced in the years to find an equilibrium between noise mitigation requirements and development of cities:

"For highways [the deduction] it's flexible, so the higher the noise level, the higher the reduction. So if the actual noise level is calculated at 55, you have to extract 2 dB to go to 53, and 53 is the maximum, that's ok. But if the noise level is 56, you can extract 3 decibels and it goes to 53, and if it's 57, you can subtract 4 decibels. So up to a level of 57 decibels it's ok. Only if you get to 58 is wrong, as then you go back to 2 decibels. […] And the only reason I can think of is that it generates possibilities to make dwellings on closer distances to highways and build highways on closer distances to dwellings."

8.1.2 Requirements for limit values exceedance

As seen in the previous section, the Noise Abatement act sets limit values for noise-sensitive destinations located within noise zones of roads, railways and industries.

Transformation plans falling within such acoustic zones require acoustic investigation to prove that the noise levels at receiver do not exceed the limit values. For transformations falling within those areas, **a preliminary evaluation of acoustic environment is required for the approval of the zoning plan** needed to actuate the General masterplan. In this situation, when noise limit values are exceeded, mitigation measures start to be defined. **The acoustic environment report, together with the proposal and verification of mitigation measures has then to be provided together with the building permit request**. Moreover, the rules of the zoning plan may contain specific noise mitigation requirements. Competitions are often held by municipalities for transformations of urban areas. also in this case, specific noise mitigation requirements can be inserted within the rules of the competition (see Figure 8.4).

In Section 3.1.1, the Noise Abatement act stipulates that when noise limits are exceeded, **noise mitigation measures designed and costs are borne by the proponent of the new transformation**, i.e. by the proponent of the new dwellings when they fall within existing noise zones, or *vice-versa* by the owner of the industry or by the authority in charge of the new road or railway, when they generate

[169] Interview conducted on 1st November 2018

[170] Interview conducted on 15th November 2018

acoustic zones that fall over existing dwellings (similarly to what established by the Italian legislation, see Chapter 5).

Moreover, mitigation measures, according to the act, should always be evaluated giving preference to measures at source, then on the transfer path, and finally at the receiver, hence on the building itself.

The Noise Abatement act specifies that, whenever a plan falls within an area where preferred limit values are exceeded, as a first step it should always been sought for any possible solution that can allow for all the buildings to fall within noise levels which are below the preferred limit values. When this is not possible and preferred limit are exceeded (as it is normally the case within urban areas), a **higher values exemption can be released by the local administration** (this was done by the Province until the modifications to the act in 2007), upon certain condition which are defined by the local policies of each municipality (see Section 8.2). Maximum limit values should not be exceeded in any case, although in the years some modifications have been added to the act, due to implementation difficulties of the requirements in the urban transformations at local levels.

One of the modifications, which is now largely diffused in urban transformations, is the identification of typologies of façade for which the noise levels are not evaluated, namely the blind façade, the noise screen (double skin) facade and the so-called *deaf facade*[171], a façade which, although having glazed surfaces, has no opening towards the outside. The ventilation supply is provided by ventilation grids and similar devices which are dimensioned according to the requirements set by the Building Decree (see Section 8.1.3).

As explained by de Ruiter[172], this is a measure that developed in time though different steps, mainly due to the limits posed by low maximum values for highways.

"So what was thought, well, in city areas is almost impossible to put screens […] So people thought well, we can build dwellings with a façade on one side, and on the other we do an embankment, no façade, but some green area, like some kind of garden [towards the road]And, well, when you have then is in fact a one-sided building, and from the viewpoint of housing is not preferred in fact that you only have one façade, but it was a possibility in fact that you had to do that.. But then people said "well, we don't need this embankment, we can make a concrete wall, and then it's ok". And later on, they said well, why should we not put a window in it? And they said ok, it can be done, but the window should not be openable. And then, you have a deaf façade".

Moreover, another shift towards flexibility for particularly difficult areas was the "City and Environment Law"[173] (Weber 2013), introduced in the Nineties. Under the "City and Environment Law," city planning can deviate from existing

[171] In Dutch: *dove gevel*

[172] Interview conducted on 1st November 2018

[173] *Interimwet Stad en Milieubenadering*

norms if a project meets specific conditions[174]. In this case, the "City and Environment Law" adds procedural requirements to the Noise Abatement act, which can be implemented when source-oriented and tailor made solutions to mitigate environmental noise are insufficient to deal with the Noise Abatement act restrictions and limitations (Weber 2013).

Figure 8.3 shows a schematization of the different noise limits to be respected and the measures which can be used in case of level exceedance.

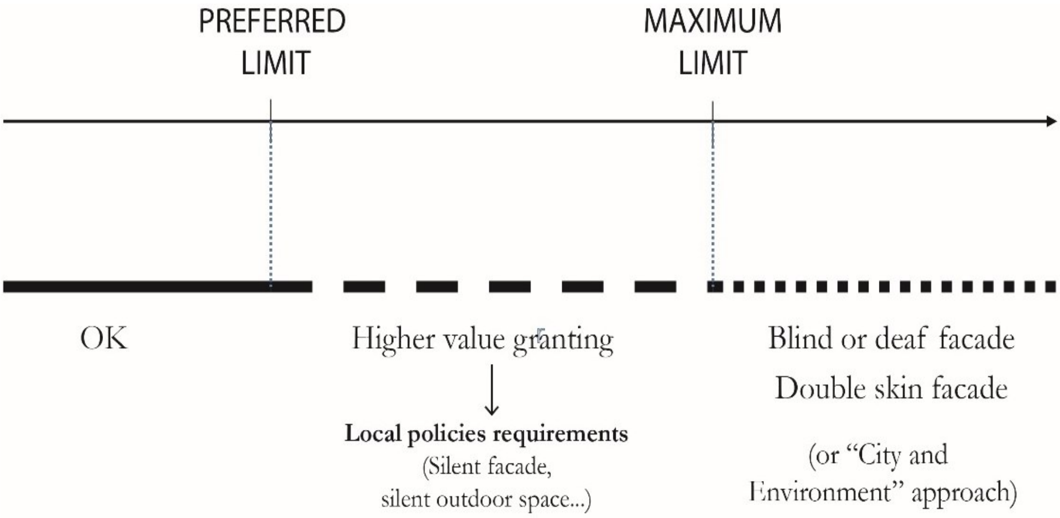


Figure 8.3 – limit values and possible mitigation measures.

8.1.3 Other laws involved in noise mitigation issues

Besides the Noise Abatement Act, legal instruments involved in the prevention and reduction of noise pollution include the Environmental law (general provision) act, the Environmental Management Act, the Spatial Planning Act, and the Buildings Decree[175].

The Environmental Law (General Provisions) Act regulates the environmental permit for companies, which entails environmental impact evaluations, including evaluation of noise impact. The law itself do not set defined noise emission limits, and the limits are specified for each company during the granting of environmental permit. Such limit values are then normally used to calculate the noise exposure of dwellings or other sensitive receivers falling within the noise zone of such industries.

The Environmental Management Act integrates the Environmental Law (general provision) act, as companies for which the environmental permit is not

[174] According to Weber (Weber 2013), the introduction of such law is part of the decentralization process that leaded to gradually move government task and responsibilities to local authorities, as from then on the local authorities started to be coresponsible for balancing environmental and spatial planning, in deciding if and where to apply the City and Environment Law in areas where noise levels from industry or infrastructure was limiting spatial development

[175] *Wet algemene bepalingen omgevingsrecht, Wet milieubeheer, Wet ruimtelijke ordening* and *Bouwbeslui*

required, are regulated by the general rules of the Environmental Management Act, in which fixed environmental requirements, including noise, are mentioned. Moreover, the EU Environmental Noise Directive is included in the Environmental Management Act, which states that conurbations of different municipalities are required to draw up noise maps and action plans every five years for agglomeration municipalities.

Finally, the Spatial Planning act regulates the drafting of zoning plans, in which environmental evaluations, including noise investigations, are involved, while the Building Decree also sets performance requirements for new or reconstructed buildings, which are involved in the noise protection of inhabitant. In particular, relevant articles of the Building Decree relating to noise are the articles 3.1 to 3.5 sets limit for indoor noise levels and 3.46 to 3.59, which sets requirement for ventilation of the rooms. In particular, while the requirements for "normal" ventilation, according to the Building Decree, can be satisfied through mechanical ventilation, the law also requires a minimum of emergency ventilation for all living environments, which can only be satisfied through natural ventilation. The amount of required emergency ventilation depends on the volume of the room to ventilate and has a role in the design of silent and deaf facades, required by the noise mitigation policies (see Subsection 8.1.2).

8.1.4 National standards for noise levels evaluation

Differently from what is usually done in the Italian context, in which in-situ measurements are mainly used to evaluate the acoustic environment of an area, in the Netherlands **the acoustic environment evaluation are usually done through calculations performed on virtual models**, as the aim is to evaluate the acoustic environment not only in the present situation, but in the ten years following the considered project, on the basis of foreseen developments of the city.

Rules for the calculation methodologies are set in the "Rules for calculating and measuring noise"[176], issued in 2012, updating the previous regulations of 2002 and 2006, which specifies how measurements can be used in particular cases.

When a building falls within the acoustic area of different sources, calculation for each source are conducted separately, according to the methodology defined in the different annexes of the law and then confronted with the limits set by the Noise Abatement act for each sound source[177]. Calculations are allowed through two different similar commercial software, designed specifically for outdoor noise evaluation through the methods defined in the law[178]. Input data for the models are provided by the authorities in charge of the specific noise source (e.g. municipalities for local roads, provinces for provincial roads., etc..), on the basis of the foreseen

[176] *Reken- en meetvoorschrift geluid*

[177] Interview with Evert de Ruiter, 1st November 2018

[178] Interview with acoustic consultant, 3rd September 2018; interview with senior acoustic specialist of DCMR agency, 10th November 2018

development of the area in the next ten years. Therefore, input data may need to be updated during the process of a zoning plan or building permit requests, due to change in previsions for the noise source development (e.g. the reduction or enhancement of traffic on a road)[179].

8.2 Local noise policies

8.2.1 Requests for the granting of higher noise values in different cities

As said in the previous section, urban transformations in areas falling within buffer zones of noise sources requires to conduct acoustic environment investigation at the stage of zoning plan as well as at the stage of building permit request. **When noise limits are exceeded, mitigation measures should be designed and evaluated, a part of the acoustic environment evaluation.** In particular, when preferred values are exceeded (which is the usual situation in urban areas) **a higher values exemption, i.e. the permit to build in areas exceeding such limits, can be required.**

The higher values exemption, previously managed by the provinces, was demanded to municipalities with the modifications of the Noise Abatement act defined in 2007. Since then, **municipalities emanated their own local noise mitigation policies**, **defining the preferred limit values** (see Subsection 8.1.1 and 8.1.2) **and the requirements to which new buildings have to respond** in order to obtain the permit to realize such transformations in noise-polluted areas. Such policies are **often accompanied by guidelines or toolboxes** setting operative suggestions for designers and planners. Policies and guidelines are either done by the Environment area of the municipality itself (as in the case, for instance, of the city of Utrecht) or by supra-local environment agencies (as in the case of Rotterdam and the municipalities in the Rijnmond region, in which policies and plan control are handled by DCMR agency).

As put by one of the policy advisors at DCMR agency[180]:

"if you have a urban design then there are three possibility: that the noise is beneath the target value, than there's no problem, you can do wathever you like, at least for noise it's no problem, and if you're above the maximum value [...] principally, you are not allowed to build, but there are a few exceptions [...] but if you're in between than you can build if you take measures, [...].So it's difficult sometimes to get those measurements in those projects, so we made a policy for Rotterdam, that if you're in this situation, then you have to have a permit from the local government to build and that you exceed the preferred value, [...]in addition we made a toolbox for designers"

[179] Interviews with two different acoustic consultants, 22nd August 2018 and 1st November 2018

[180] Interview conducted on 9th August 2018

This kind of decentralization of policies leaded of course to differences between cities. different requirements can be set, and also different values can be considered as preferred limit to be satisfied for the quiet spaces (mainly because of the +5 dB granting for local roads, seen in the previous section).

As explained by an acoustic consultant, in an interview conducted in September 2018:

"Each city has their own set of rules and also different in what they think in terms of sound levels… [for example] you have Amsterdam, Rotterdam, the Hague and Utrecht. They all require a silent façade [i.e. a façade at which the noise level is below the preferred limit value], but for it you have den Haag 53 [dB(A) as limit], Rotterdam 53, Amsterdam 48, and Utrecht is 48 or the sound level minus 10 dB.,. sort of a range

So that's one thing… we also see that in terms of balconies, some of them say "well, if you have a balcony, you should make it a silent balcony". So Amsterdam says, same as goes for the façade, take care of a balcony when someone can sits quietly and no more than 48. Utrecht says no.. 53 is ok, Rotterdam says 53 is ok and the Hague doesn't have a demand at all for the balcony

[and] sometimes you have a sort of specific demands for.. when it comes to the way you divide your rooms in your apartment. That's also something that's different. For Utrecht you have to have at least… if you have a silent façade at least 30% of your rooms should be on this silent façade, and Amsterdam doesn't have rule, so that's also different, for the maximum of the façade.. and some of them, that's also different, especially in the Hague they have an exception for small houses, if you say student houses or elderly people, so just small apartments.. you don't have to meet the requirements, so 50% of the building in total doesn't have to have a silent façade, so you have a whole building where you have those apartments one-sided… sometimes you have a building where you have this, you have a corridor and on this side you have apartments and on this side apartments, you have an internal corridor to get to your apartment, and one side is 58 let's say and the other side is 48.. then in the Hague this is ok, because 50% of the apartments has a quiet façade. So that's in the Hague… but in Amsterdam wouldn't be ok, because in Amsterdam they say "well, every apartment should have a silent façade" [...]

… but also in terms of other requirements, expecially Amsterdam has a whole sets of requirements for solutions and they say something like "if you make a screen in front of your façade it has to be at least half a meter from the façade" so even these things, they specify it."

Table 8.1 reports a comparison of the requirements for higher values exemption in the major cities of the Netherlands.

Table 8-1– comparison between the requirements for higher values exemption in The Hague, Rotterdam, Amsterdam and Utrecht (elaboration of the author on the basis of the presentation "Soundproof facade principles selection" [=*Geluidwerende gevelprincipes selectie*] provided by DgMR acoustic consultants during the interview conducted on 22nd August 2018)

Parts	The Hague	Rotterdam	Amsterdam	Utrecht
Silent façade	53 dB	53 dB	48 dB	48 dB (or higher noise value – 10 dB)
Silent outdoor space	-	53 dB	48 dB (possibly up to 53 dB)	53 dB (max 5 dB higher than silent façade)
Cumulative noise requirements	Max 69.5 dB	-	-	
Layout requirements	For the layout of the dwellings it is recommended to situate at least 1, but preferably several rooms on the silent facade. Preference is given to bedrooms.	Accommodation areas, especially the bedrooms, should have sides on the silent facade so that they can be naturally ventilated without being disturbed by noise.		The house contains sufficient living space on the side of the silent facade. This applies to at least 30% of the number of accommodation spaces or 30% of the surface area of the accommodation area.
Exemption	For unilaterally oriented one- and two-room residences, often elderly or student residences, and 'Urban villas' a maximum of 50% of the residences may deviate from the condition of a noise-free side.		Other solutions are possible as long as it is demonstrated that the goal of sleeping quietly with the window open is achieved.	For non-independent accommodation (old people's centres, student units) or independent accommodation with a surface area ≤ 30m2, the requirements do not apply at individual housing level. At building level, at least 50% of the housing units must be situated on a facade with a noise level of no more than 5 dB above the preferred limit value.
Re-use policy	Same as new buildings	Negotiable, compensation possible in consultation with DCMR.		

Moreover, the interpretation of different local offices on solutions for maximum level exceedance can also affect the integration of *deaf facades* and screens in projects, as *"when it comes to definitions you see this difference in the cities as well.. it's the same law, but different understanding of the law"*[181]

[181] Interview with an acoustic consultant, 22nd August 2018

For instance, different municipalities can have different interpretation of non-openable windows to be used in *deaf facades*, as pointed out by two of the interviewed architects[182]:

"there's the permanent ventilation [requirement], but when you have emergency ventilation [see Section 8.1.3], *that you can have a lot of cubic meters ventilation in one time, and then you have to open a window. But in deaf facades, that's not allowed.. and.. it depends on.. some parts of the Netherlands they accept that you, in emergency situation you open a window, and in other parts they say no, so it's not.. is the same law, but the interpretation is different in every city […]*

And in some part of the Netherlands, they say "oh if you only open that window to make it possible to clean it, then you are allowed to open it [in the deaf façade]". But there are cities as well, or places in Netherlands, they say, like Rotterdam, 'it's a deaf façade, so you are not allowed to open it, not for cleaning, for nothing'"

Interpretations can also vary in the definition of ventilation allowed within the deaf façade. As pointed out in the same interview:

".. when you have a deaf façade*, in Rotterdam is not allowed to make ventilation but sometimes.. in Amsterdam you are allowed to do something to ventilate through that wall.. is not a real solution for a deaf façade, but they say "ah.. why not", so that depends on the city. And… not every year. Because maybe 5 years later is not allowed, so.. you don't know exactly"*

Similar situations happen with the use of screens, which can be used in front of facades and windows in order to reach noise levels below the maximum value and be therefore allowed to have openable windows:

"Another kind of escape is to say "well, this is the building, and we put the glass screen at a short distance" and well, at first the authority said "well, of, a screen, but the screen may not be connected or anchored to the building"..[…] now the anchoring is permitted.. this is due to the definition of a screen, so that's the point, what is a screen, what is a façade, that's a matter of definition. […] it should be external climate condition [between the screen and the façade] and it's sometimes a difficult judgement, and there are not strict measuring methods, because it depends on the wind conditions, etcetera, so.. it's not too easy […]and that is the question, yes of you have some openings for ventilation, but what air velocity do you assume in these opening? You don't know."

"[…] is a matter of interpretation and definition, what is a screen. And of course everybody knows what is a screen, but if you go to the edge, then when does a screen stop being a screen? That's difficult, is not unchangeable".[183]

[182] Interview conducted on 29th October 2018

[183] Interview with an acoustic consultant, 1st November 2018

"[...] there were huge discussions about this type of solutions, because they said "ok but then is [the screen] becomes the outer façade...so in the end you will have to calculate levels on the screen [...]at the end they said, well, if this [space between screen and façade] is outdoor air quality, then you don't have to call the screen the façade. [...] and it's not defined what is an outdoor climate [..] for example in Amsterdam they say it should be at least half meter from the façade.."[184]

8.2.2 Local noise policies and guidelines in Utrecht

In the previous Subsection it has been shown how the requirements can change within different municipalities, and how municipalities can decide to emit toolboxes and guidelines to provide more specific operative indications to designers. In this Subsection, **a closer view on the major point of the policies and guidelines of the municipality of Utrecht is provided**, as the case-study presented in Chapter 9 is located in this municipality.

The first local noise policies were issued in 2007, following the modifications in the Noise Abatement act, and remained in force until 2013. The noise policies for 2014-2018 took over the previous ones, leaving it substantially unchanged, in particular with respect to requirements for dwelling projects[185].

In their policy, the municipality of Utrecht pointed out that, although endorsing the idea behind the research obligation posed by the Noise Abatement Act, committing to the source-transmission-receiver order of preference for research in noise mitigation measures, they excluded useless research on highly problematic mitigation measures such as high noise barriers in the middle of the city. The noise policy from the city of Utrecht underlines how, being the local policies leading when determining the options to be considered, spatial planning and **road management are therefore not unnecessarily burdened by "unrealistic or unfeasible measures"**, and the "quality of life is achieved by means of conditions such as the higher values exemption", for which the **silent façade remains "the most important condition**"[186] (see Section 8.1.2 and 8.2.1), hence **focusing mainly on mitigation measures at receiver.**

The policies state therefore that higher values up to the maximum level are accepted, provided that at least **one façade of the building has a noise level corresponding to the preferred value** (see Section 8.1.1) or 10 dB less than the higher recorded value (see Section 8.2.1). Moreover, at **least 30% of the rooms or 30% of the surface of the house needs to be bordering the silent façade and at least one of the outdoor spaces** of the house must be exposed to noise levels that are **no more than 5 dB higher than the silent façade**.

[184] Interview with an acoustic consultant, 22nd August 2018

[185] Geluidnota Utrecht, 2014-2018

[186] Geluidnota Utrecht, 2014-2018

The city of Utrecht has moreover established the use of **practical guidelines** for “"Noise aspects of plan development in the municipality of Utrecht"[187].

The first versions of the guidelines, issued before the modification of the Noise Abatement act in 2007 and the consequent production of local noise policies, provided a synthesis of the requirements of the national law affecting building plans, both in case of noise-sensitive receivers such as dwellings and of potential noise sources such as companies.

Moreover, the guidelines pointed out how the Provincial authority for higher value granting already set some of the requirements which will be then resumed and deepened by local policies and further guidelines in 2007. In particular, it pointed out that every house must have a silent façade, with living spaces situated “as much as possible” on that façade, and outdoor spaces have to be located, when present, on the silent side (at least one of them).

They also already recommended to submit the spatial plan or building plan to the Environment area “at an early stage for advice”, hence promoting informal exchanges before the final evaluation of the zoning plan or the building permit request, in order to promote a smooth integration of noise mitigation requirements within the process[188].

Guidelines emitted after 2007 then referred also to local guidelines translated the requirements into a list of practical indication for building design, In particular, the guidelines reported that:

- the **minimum width of a silent facade** is 1.8 m;

- the **minimum height of a silent facade** is 2.6 metres, while the receiver height in the examinations is at least 1.5 metres;

- there must be at least 1 living space facing the silent façade (provided the 30% requirement mentioned above)

- there must be at least 1 window or door that can be opened in the silent facade.[189]

As far as the observation of the Building Decree ventilation requirements are concerned, the guidelines specify that if sound-proofing facilities are used to create a silent facade, there must still be **a permanent natural outdoor climate** directly in front of the shielded façade, and that:

- the space between the screen and the facade must be ventilated by means of permanent, non-closable openings, with a ventilation capacity that is sufficient to satisfy the law requirements, on the basis of the volume of the rooms that need to be ventilated.

And it is not permitted to close a noise barrier in such a way that the permanent ventilation requirements are not satisfied[190].

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[187] *Geluidsaspecten bij planontwikkeling in de gemeente Utrecht*

[188] *Geluidsaspecten bij planontwikkeling in de gemeente Utrecht,* 23rd February 2006

[189] *Geluidsaspecten bij planontwikkeling in de gemeente Utrecht,* April 2008

[190] *Idem*

Without going too much into the technical specifications for ventilation, it is sufficient to point out that such requirements have of course an impact on how facades can be shielded in Utrecht with respect to other municipalities with different requirements. For instance, verandas with sliding screens can be considered as quiet outdoor spaces only as long as the required noise levels can be reached even when the screens are opened, in order to provide the required natural ventilation. This is not the case, for instance, in Amsterdam, when it is accepted that movable screens are closed to provide the required noise mitigation[191]. Of course, such differences have an impact on outdoor spaces layout, as will be shown in Chapter 9.

Such very specific requirements were then deleted from the last versions of the guidelines, as reported by two members of the Environment Area of the city of Utrecht[192].

"We saw that within those rules, they still came up with.. "solutions", that we didn't think fitted the purpose of a quiet façade. So perhaps literally it did fulfil the requirements, but it… how do you say.. we thought well, that's not how we vision a quiet façade.[…]But they were so clever that they did fulfil all the requirements we had in this document [guidelines].

[..]So we skipped the ventilation requirements […] We also skipped a lot of details, because what we noticed is that, the more details you give in your requirements.. seems contradictory, but the more an architect or a consultant is trying to fit something within those requirements, and come up with a solution we don't want. So we skipped a lot of those requirements, and made it more.. general[…]: back to basic, "we want a quiet façade".

we have added a sentence about.. living quality, that we not only look at the noise level, and ventilation requirement, but we demand a living quality. So we make it less detailed and more in general demands."

However, such requirements were still in place during the process of the selected case-study, and Chapter 9 will show how they worked within the specific project.

8.3 Summing up

In the present chapter, an overview of laws and regulations concerning environmental noise mitigation in the Netherland has been provided. Two different levels of regulations have been examined**. For the national legislations, the main normative instrument, i.e., the Noise Abatement act**, has been presented in particular with respect to the requirements it sets for noise mitigation for dwellings, together with a brief overview of the other laws involved in the process and the national standards set for noise levels evaluation.

[191] Interview with housing developer, 18th September 2018

[192] Interview conducted on 8th November 2018

Moreover, the chapter examined the **local noise policies**, though a comparison of the requirements of four major cities in the Netherlands, and **focused expecially on the noise policies of Utrecht**, where the selected case study is located, **and on the guidelines emitted by the municipality** for the practical application of noise policies requirements.

It has been shown how the Noise Abatement act sets a series of limit levels, in particular **a preferred limit level and a maximum acceptable limit level**, which differ for different sound sources. The act requires the **evaluation of the acoustic environment,** through an acoustic environment report, both **at the stage of zoning plan**, when a preliminary project is set, **and at the stage of building permit requests**. Moreover, it defines some measures that can be taken when maximum noise levels are exceeded, while **transfers to the municipalities the definition of measures to be taken when noise levels are set between preferred and maximum noise limits.** Municipalities can also differ in the interpretation of practical implementations of the national directive on measures to be taken above maximum levels.

Figure 8.4 shows a summary of the steps that a transformation subjected to zoning plan has to undertake in order to be actuated, together with the obligations that have to be fulfilled in each step, with respect to environmental noise mitigation.

Figure 8.5 shows a schematic representation of the regulatory framework concerning environmental noise mitigation, that have been examined in the present chapter, with a brief note on the aspects of each law and policy.

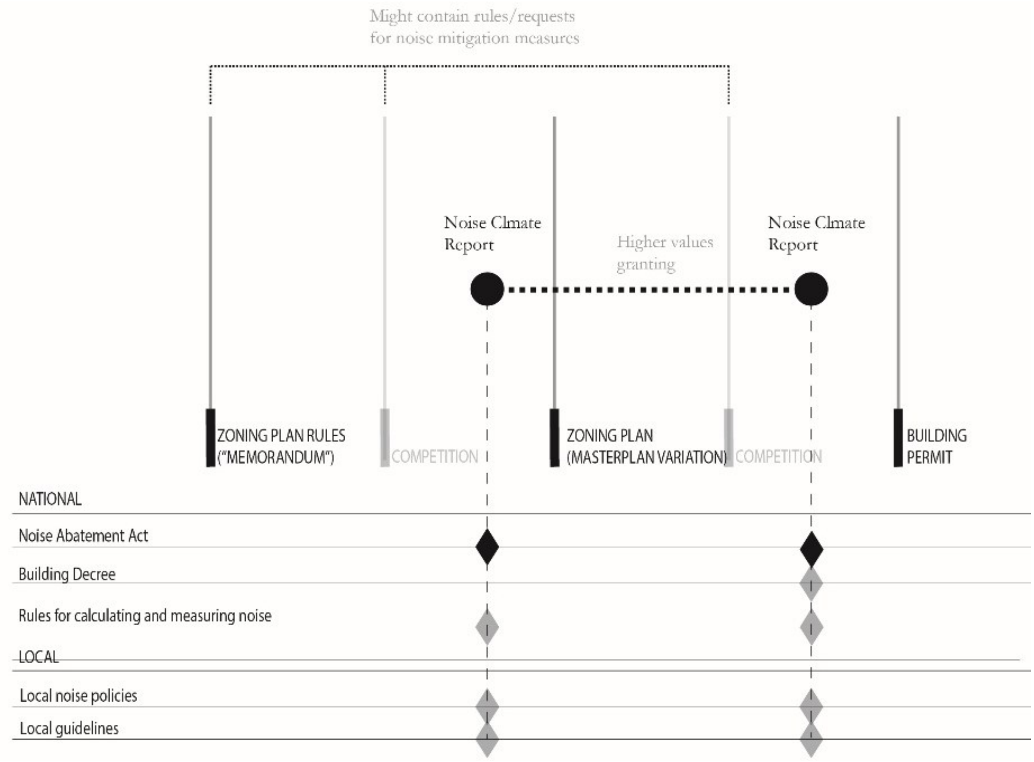

Figure 8.4– obligations to be fulfilled for each step of the transformation, with respect to noise mitigation requirements. For each requirement, in the list of laws and policies the black symbol represents the law that explicitly requires such document, while the grey one indicate the laws which may be involved, by setting further requirements and specifications

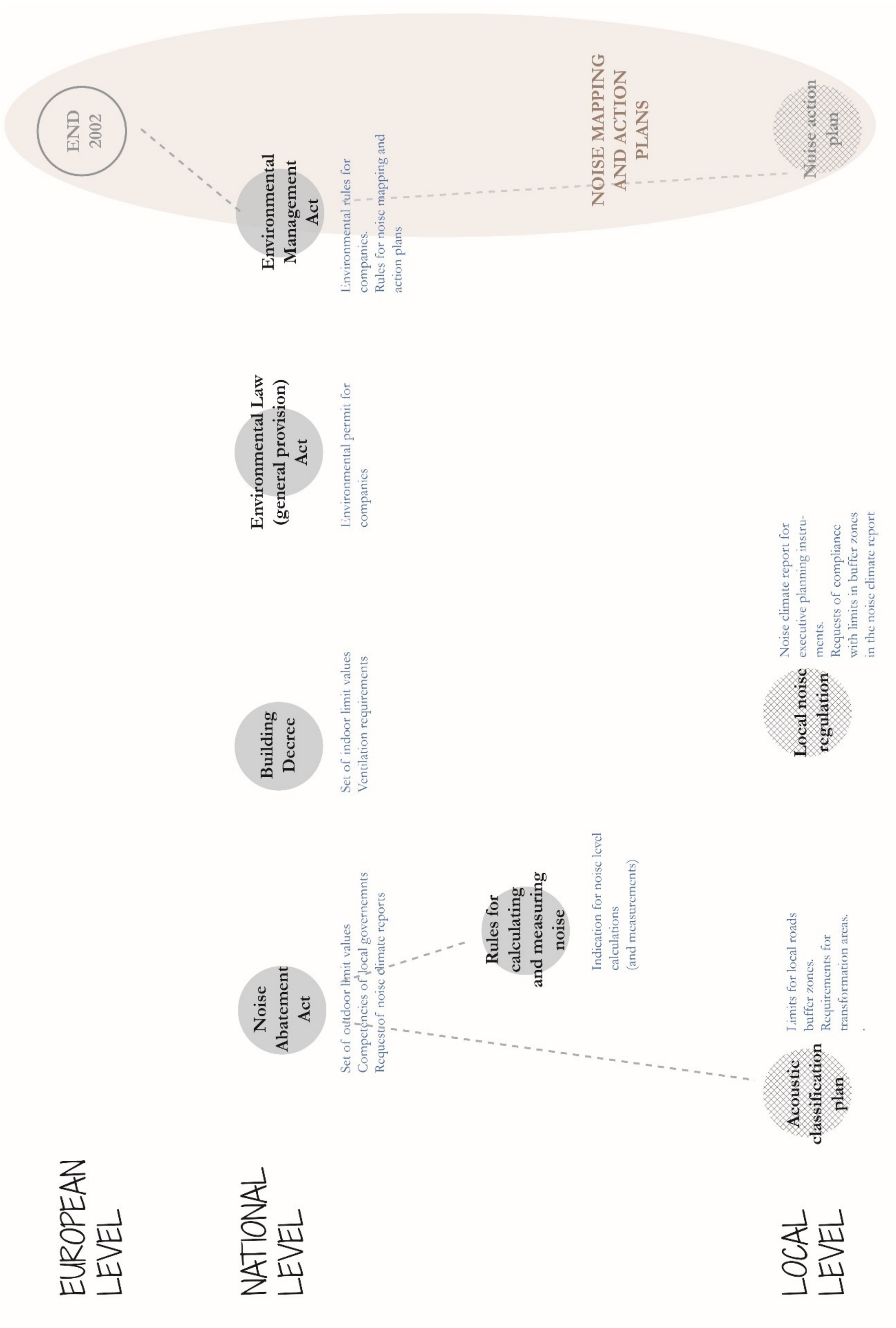

Figure 8.5– schematic representation of the regulatory framework presented in the chapter

Chapter 9

9 Testing the methodology: A case study in Utrecht, the Netherlands

Overview

Chapter 9 focuses on the focuses on the case-study of a urban transformation in Utrecht, The Netherlands. The aim is on one hand to answer to research questions defined in Chapter 2 with respect to this case-study and on the other hand to test the visualizations crafter for the Turin case-study on another case-study.

Section 9.1 briefly introduces the area location and characteristics.

Section 9.2 starts the exploration of the process through the maps described in chapter 4, providing a general overview of the process through the main map.

Sections 9.3 and 9.4 examine more in detail the whole process trying to conjugate the chronological narration of the process with the analysis of the different *matter of concern* derived from the analysis. In particular, section 9.3 presents *matter of concern* on mitigation solutions developed through the process, while section 9.4 focuses on the *matters of concern* on verification methods emerged in the last phase of the process.

Section 9.5 goes back to a general overview of the process, focusing on the role of noise mitigation policies and on how the local office acted in the implementation of the policies.

Section 9.6 sums up the findings, following the research questions detailed in Chapter 2 and providing an evaluation on the use of the maps.

9.1 Integrating "quiet facades": a case study in Utrecht

The case-study presented in this chapter, differently from the Turin case-study, is a process that was already closed before the research took place. This is due to the limited time-frame for the conduction of the research and to the difficulties that are intrinsic in the adopted methodology. Therefore, a direct participation through in-field observation of the process was not possible. Nevertheless, this did not interfere considerably with the methodology, as a collection of interviews with involved stakeholders and documents produced in the process, in line with ANT-based researches, could be performed and the process used to collect and analyse materials was the same as the one adopted in the Turin case-study. This aspect will be further developed in the Conclusions of the thesis, where strength and drawbacks of the research methodology are examined.

The case study is located in an area of about 14000 m^2 in the northern area of the city of Utrecht, in the Overvecht-Zuid district. The plot is located at the south-western edge of the district, between a residential area with two-stories terraced houses and a sewage treatment plant. It is bordered by double-lane streets (*Brailledreef, Taagdreef, Zamenhofdreef*) and by a local one-lane road on the north-east side (*Bruisdreef*). In particular, the *Brailledreef* forms an important connection through the Overvecht district and is a primary axis for the traffic[193] (see Figure 9.1).

The area was formerly occupied by a school and it was ruled by the *Overvecht* zoning plan, adopted on 26th August 1982. The plan assigned to the area the function of "public and particular buildings", intended for religious, educational, socio-cultural, medical, sports and public service purposes, "Green facilities" and "Motor fuel selling point"[194] (see Figure 9.3 a).

The 1982 zoning plan continued the transformation of the area, started in the Sixties, when the Overvecht district was first planned and developed as a new area for the expanding city.

The Overvecht was planned as a mainly residential area and is "a typical product of its time"[195]. Because of the isolated location, at the time, with respect to the rest of the city, a fairly autonomous part of the city was realised, which did not take into account allotments or typologies from the rest of the city, but was instead organized with the idea of an independent district, dividing the area into smaller residential units "that made it easier for residents to feel safe there"[196].

The area was therefore organized into "recognizable neighborhoods that functioned as close knit communities"[197], surrounded by green areas in which where punctually inserted services and facilities buildings. The residential neighborhoods where planned according to a recognizable "stamp", composed by low to medium-rise buildings, oriented to the best sun exposure, while the buildings in the green differed from this due to form and function[198] (see Figure 9.2).

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[193] Acoustic environment report on the *Bruisdreef* project, 7th February 2007

[194] "Memorandum of principles" (in the original: *Nota van uitgangspunten*) *Bruisdreef*, March 2008

[195] Explanatory report of the zoning plan *Bruisdreef bestemmingsplan*

[196] *Spelregels voor herontwikkeling van Overvecht-Zuid*, Augustus 2008

[197] Explanatory report of the zoning plan *Bruisdreef bestemmingsplan*

[198] *Spelregels voor herontwikkeling van Overvecht-Zuid*, Augustus 2008

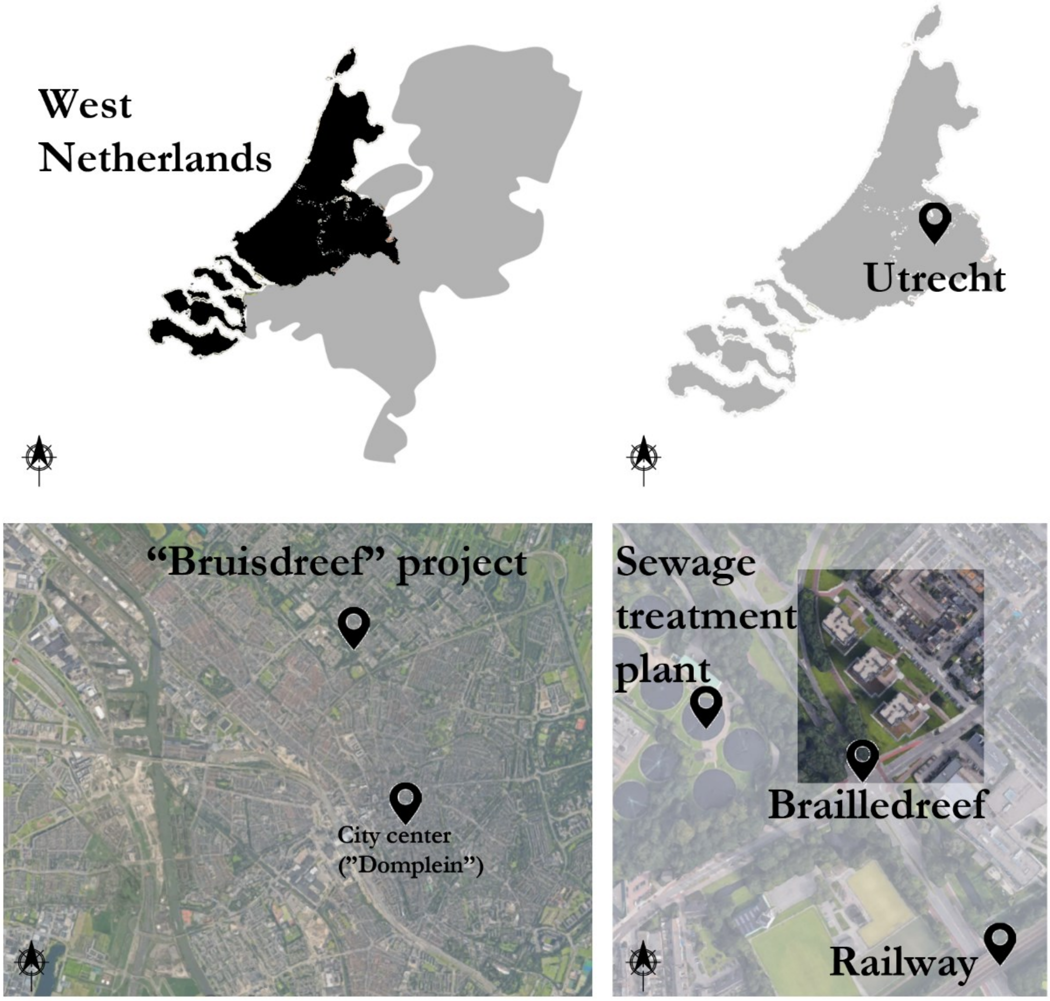


Figure 9.1- Location of the city of Utrecht with respect to The Netherlands and the West Netherlands region; location of the area with respect to the city of Utrecht: location of roads, railway and sewage treatment plan with respect to the area

According to such directions, the area was therefore used for education facilities until the early 2000s, when the school was relocated as part of the "Master Plan for Secondary Education"[199], adopted by the municipality of Utrecht in 2002.

A residential use was envisioned for the plot by the *Overvecht spatial vision* 2004-2020, adopted by the local council in September 2005, that defines the main structure of the district and the desired directions for the development, and in particular the *memorandum of principles* for the Overvecht Zuid district , which set rules for the redevelopment of the area.

The stated aim of the *Overvecht spatial vision 2004-2020* and the related *memorandum* for Overvecht Zuid was to retain the distinction between "stamp" neighbourhood and green areas and strengthen it[200], hence giving different direction

[199] *Masterplan huisvesting Voortgezet Onderwijs*

[200] *Spelregels voor herontwikkeling van Overvecht-Zuid*, Augustus 2008

to build inside the “stamps” and outside of it, in the “green areas”. As reported by the planner of Utrecht municipality who was involved in the investigated project[201]:

“ […] what you see is that in the last 40 years, a lot of facility in the area lost their function, so[…] when you don’t have facilities, you make dwellings, than you have to take care that the dwellings don’t look like this [the neighborhood from the Sixties], but you have a building that is… looks like in the green.”

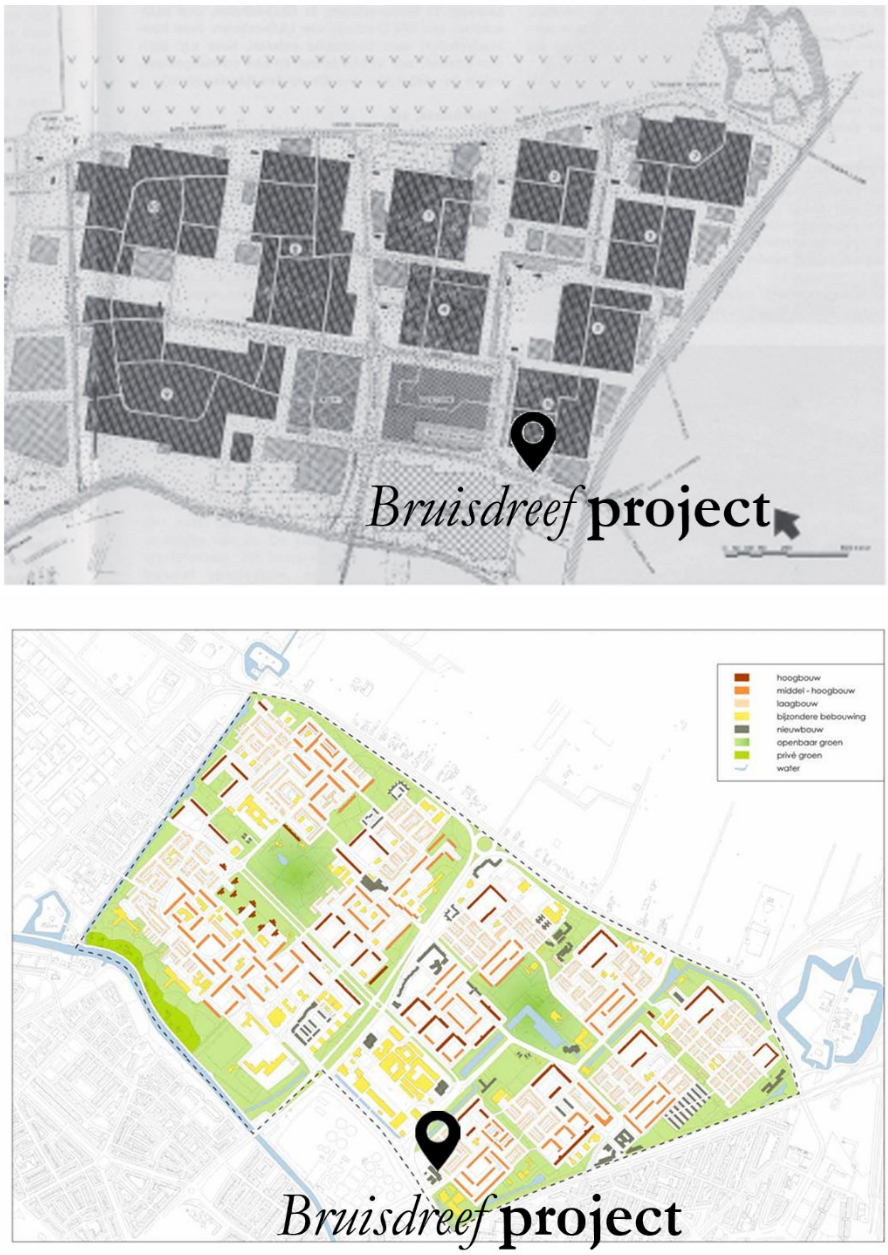


Figure 9.2 - (a) schematic drawing from the original *Overvecht* plan, where the neighbourhoods structure is clearly recognizable; (b) plan of the area with different building types. Service buildings in the green are marked in dark grey. The location of the *Bruisdreef* project, investigated in this chapter, has been indicated with black tag. (Elaboration of the author on extrapolations from *Spelregels voor herontwikkeling van Overvecht-Zuid,* August 2008)

[201] Interview with planner of the Utrecht municipality, conducted on 17th October 2018

The goal for future buildings "outside the stamps", such as the ones of the investigated project, was therefore to "build in a green environment. The buildings should be interwoven with the green and should deviate from the stamps, so that the contrast between stamps and frames remained clear"[202]

In the original development plan the building in the greens not only should have differed from the "stamps" with respect to function, but also with respect to form, as slender high towers were originally envisioned. Such formal distinction was kept and strengthened in the directions of the *Overvecht spatial vision 2004-2020* and in the *Overvecht zuid* memorandum[203].

The new residential function envisioned for the plot where the case study is located was of course not in line with the destinations defined by the 1982 plan. Hence, a new zoning plan was needed for the redevelopment of the area.

On 25 January 2005, the starting note for the Bruisdreef zoning plan was approved, and the school building was demolished shortly afterwards.

As indicated by the Spatial Planning Act, the rules of the new *Bruisdreef* Zoning plan were set by the adoption of a *Memorandum of principle* in March 2008, with the aim of describing the development opportunities for the area and setting the general rules for buildings and public spaces[204].

The indications given by the *Memorandum of principles* identified a layout composed of separate buildings in a green environment, that had to "deviate from the stamps so that it is contrast between stamp and frame remains clear." The new buildings also had to provide as much open view as possible for the mow residential buildings on the north-east side of the plot, with "limited footprint of the buildings" (0.2 ground space index Open Space Ratio (OSR) must be higher than 0.4.)[205] (see Figure 9.3b).

[202] *Nota van uitgangspunten Buirsdreef,* March 2008

[203] *Idem*

[204] "Memorandum of principles" (in the original: *Nota van uitgangspunten*) Bruisdreef, March 2008. As explained by the project leader in charge of the nvestigated project in an interview conducted on 7th November 2018, the rules of the zoning plan are requeted as a first phase of the process, while the elaboration of the project in the zoning plan, with envisioned buildings and related evaluations (including the noise climate evaluation, as requested from the Noise Abatement act,

[205] The Ground Space Index (GSI) is the ratio of the footprint (area ground floor) in relation to the surface of the building surface. Open Space Ratio (OSR) is the ratio between open space and the area of the plan area. It gives an impression of the building typology.

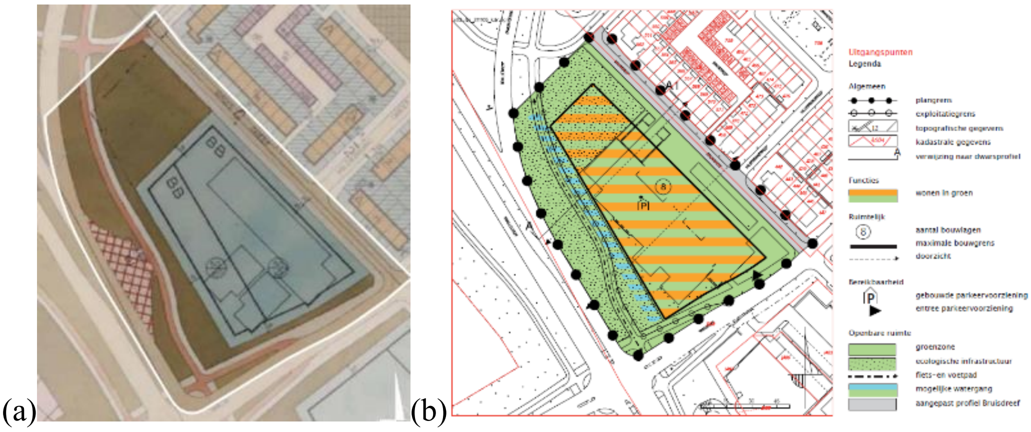


Figure 9.3 – (a) land destination as defined by the 1982 plan the grey area is destined to public buildings and can be seen the perimeter of the school, while the red-hatched area is destined to fuel selling; (b) land destinations as defined by the 2008 *Memorandum of principles*

Due to this requirements, tower-like buildings with a basement car-park, in order to maintain the green at the ground level, were required.

A new design of the area was defined by two private proponents that partnered on the project since the beginning of 2006, following the rules defined by the planning area, which were then stabilized into the *Memorandum of principles* in March 2008. Three towers were designed, of which one was destined to apartments to sell to the free market and two to apartments to be rent by one of the proponents[206]

The process temporarily stopped in autumn 2008 and the buildings design was changed during 2009, due to the exit from the project of one of the two proponents who had originally partnered to develop the project and purchase the land from the municipality[207]. The division into three different buildings was kept, while the floor plan of each building was modified to host 5 flats per floor instead of the originally-planned 3 flats (as will be better explained in the following sections), as the remaining proponent considered the originally planned flats as too large, also due to the changes in the building market due to the economic crisis[208]

Two of the towers were turned, so as to provide a more open view to the low-rising houses on the north-east side. A higher distance between the buildings was also allowed by the realization of three separate basement car parks (one for each building), with three separate entrances instead of a unique one, as originally planned.

[206] Interview with the acoustic consultant, conducted on 3rd September 2018; Explanatory report of the zoning plan *Bruisdreef bestemmingsplan*

[207] Interview with the architect in charge of the project, conducted on 10th October 2018; e-mail exchange with one of the proponents involve in the process, 22nd October 2018

[208] Explanatory report of the zoning plan *Bruisdreef bestemmingsplan*; e-mail exchange with one of the proponents involve in the process, 22nd October 2018

The zoning plan adoption and the granting of the related building permit were then emanated in a unique, coordinated procedure at the end of the project in December 2011[209].

Figure 9.4 shows a 3D-model of the 2011 project (a) and pictures of the realized buildings (b).

Due to the location of the buildings with respect to roads, railway and sewage-treatment plant (see Figure 9.1b), the project falls within the noise area of all the above-mentioned infrastructures and facilities. Hence, noise investigation had to be carried out following the Noise Abatement Act (see Section 8.1).

The high noise level to which the buildings resulted to be exposed, together with the indication for mitigation measures set by local noise mitigation policies and guidelines, greatly affected the development of the buildings, as will be shown in the following sections.

(a)

(b)

Figure 9.4 - (a) aerial view of the 3D model of the project (extrapolated from the documents presented for the zoning plan approval); (b) pictures of the buildings, October 2018

[209] Interview with the project leader form local administration, conducted on 7th November 2018; *Vastselling bestemmingsplan Bruisdreef,* 8th December 2011.

9.2 An overview of the process through the "new visual vocabulary"

As previously done for the Turin case-study, the exploration of the starts from a general overview of the process, with specific focus on the noise mitigation issues, using the general framework map presented in Subsection 4.3.1.

On the upper part of the map **("human actors" section) there are the documents produced during the process**, while the "**policies" part** presents then an **overview of when noise-related policies or other policies and requirements entered the process**. In the upper part of the map, reporting all the documents issued by the involved human actors and organizations, it can be seen that some communications are reported in grey rather than in black. The grey colour represent communications for which a precise date cannot be established, although their presence was reconstructed through the information provided by the interviewees and the other documents that could be examined. This is the case, for instance, of the exchanges between architect and acoustic consultant in late 2006-early 2007, in which both acoustic consultant and architect reported to have a constant exchange in person and through the phone, and main effects on the project could be reconstructed through drawings provided by them. The dates in which such exchanges were held and leaded to modification in the building layout could be estimated through emails that reported the date of scheduled meetings between architect, acoustic consultant and proponent. However, since no reports were kept of such meetings, it is not sure whether a specific topic (e.g. design of the balconies) was discussed in that exact meeting or either on phone calls held around the same period. The dates reported on the drawings however allow to determine when a certain request was integrated in the design, allowing to have a good estimation of the time in which the exchange happened.

In the **"concerns" part**, **each *matters of concern* is represented by a bar**, whose length identifies the duration of the controversy. Finally, in the lower part of the map it can be seen **the acceptance or refusals of noise reports ("traffic-lights") and the modifications of the building due to the noise mitigation requirements** (see Subsection 4.3.1).

By looking at the cloud of documents produced in this process, it can be seen that there is a quite small group of human actors and organization involved in the process.

The process only included two phases ("memorandum of principles" and "zoning plan approval and building permit", as the zoning plan approval and the granting of the building permit were manated in a coordinated procedure, as indicated in Section 9.1. Moreover, the "memorandum of principle" in this case did not contain specific rules with respect to noise mitigation which could made the project deviate from the path already agreed between the proponent and the Planning area and Environment area. Hence, an official presentation of the acoustic environment reports was only requested once at the end of the project.

This is underlined also by the fact that the “stop and go” in the process, hence the responses from the local Environment Area to the documents presented for the requested of zoning plan approval and building permit granting are only in the last part of the process (red and green light in the lower part of the map).

Therefore, **the *bureaucratic exchange* with the local Environment area only took place at the last stages of the process, while in all the rest of the it can be witnessed a *symbolic* exchange** mainly between the proponent, the acoustic consultant and the architect, bu also between the practitioners and the local Environment Area (Armando and Durbiano 2017). The City planning Area is involved only at the beginning of the process, with respect to noise mitigation issues, however with an important role in the first *matter of concern*, as will be further explored in Section 9.3. Moreover, the Province offices and the local Mobility Area are involved in the process only to supply the input data for noise calculations, but are not directly involved in any of the *matters of concern*, as will be further explained in Section 9.4.

In the map can be seen a first series of documents and concerns in 2006-2007, which correspond to the first project, and a second one starting in 2009, which correspond to the second project, after the withdrawal of one of the proponents from the process, as seen in Section 9.1. The second series of exchanges and concerns ended then with the approval of the zoning plan and the granting of the related building permit in December 2011.

By looking at the *matters of concern* emerged during the process, it can be seen how they are **mainly related to mitigation solutions at receiver, hence on the building itself**, and to verification of the noise levels in the later part of the process. No concerns emerged in relation to mitigation at source or their realization timing, since, following the principle declared in the local noise policies (See Subsection 8.2.2), no mitigation at source were envisioned, hence all the mitigation measures were realized at the receiver and were therefore realized together with the construction of the building itself, without posing issues on the realization timing.

Consistently with that, it can be **seen in the “effect” section how a rapid succession of building modifications happened,** expecially during the second project (end 2009-mid 2010), due to nioise mitigation issues. This will be further explored in Section 9.3.

Moreover, it can be seen how **the *matters of concern* on mitigation measures at receiver mainly involve an exchange between private practitiones**. This is also underlined by the fact that the acoustic consultan did not only produced completed reports to be presented to the local offices, but also written communications (emails) and acoustic “memoranda”, namely “unofficial”, short reports to provide advices to the proponent and architect on the project (see documents in the upper part of the map and related legend).

***Matters of concern* related to verification of the noise levels emerged at the later stages of the process**, and involved the local Environment area and the acoustic consultant, as will be further explored in Section 9.4.

Finally, by looking at the “policies” section, it can be seen how **noise-related policies had an agency through all the process**, being involved in all the *matters* *of concern*, while other policies and requirements were only involved in precise moments of the process. This will be further explored in Section 9.5.

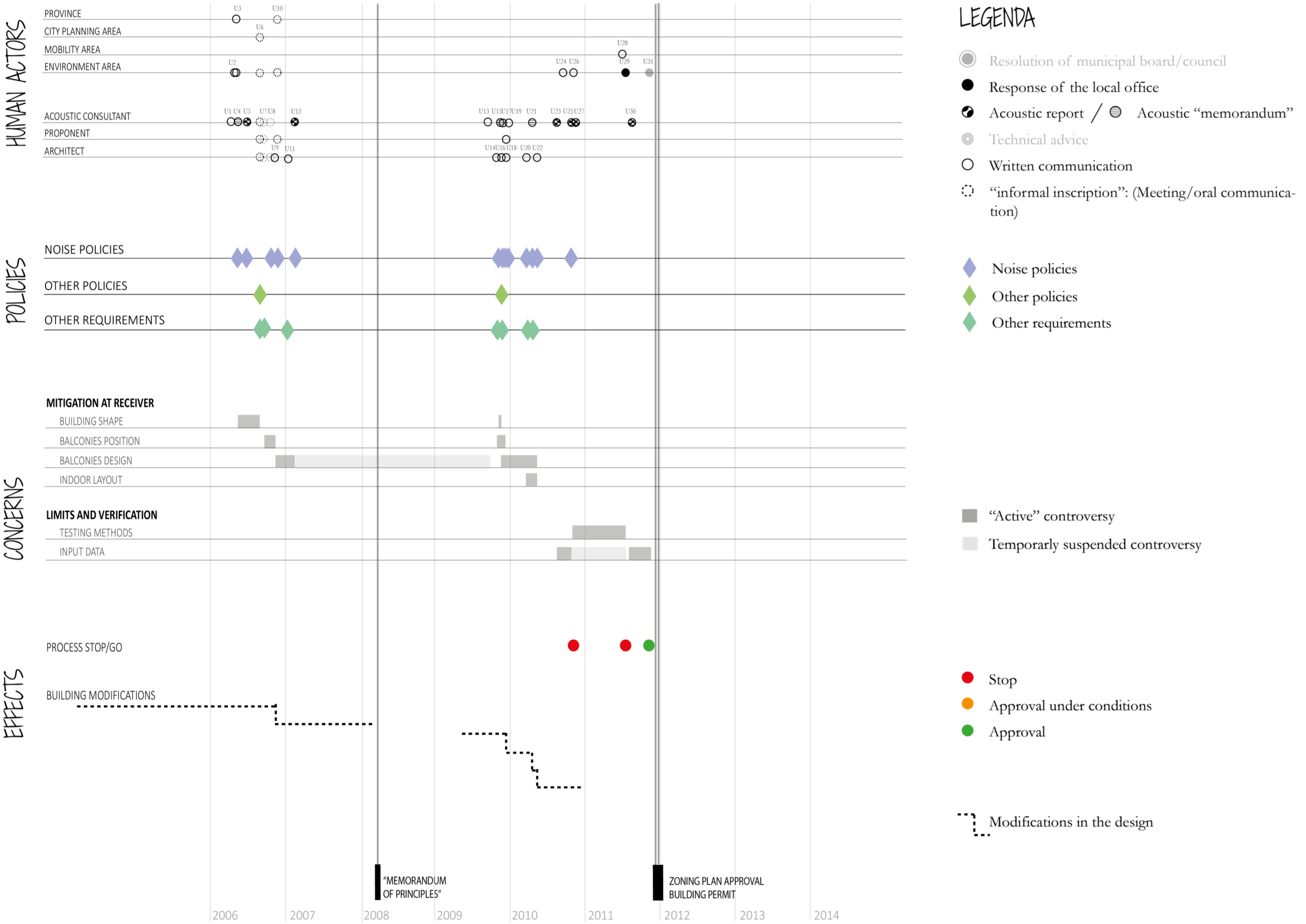


Figure 9.5 – Map of the overall process of the "Bruisdreef" project

9.3 . The controversies on mitigation solutions and the effects on the process

9.3.1 Defining building shape

Evaluations on the noise aspects of the project started in April 2006, after the proponents contacted the acoustic consultant in order to commission the work[210].

A3-tower layout was already envisioned by the Planning area of the municipality, due to the directions already defined in the *Overvecht vision 2004-2020*, as reported in Section 9.1[211].

While sending the input data for noise calculation models through emails in April 2006 [U2-U3], requested by the acoustic consultant [U1], the Environment area put however in light how the particular position of the buildings would probably require a granting for a higher values exemption[212], due to the presence of different noise sources (see Figure 9.1b).

A first acoustic *memorandum* produced by the acoustic consultant on 10th May 2006 [U4] as an initial estimation, confirmed the complex situation of the acoustic environment. Calculations on a 3-tower model, with 6 to 10 storeys towers, were conducted on the basis of the local City Planning area requests (see Figure 9.6a). The calculation put in light how, due to buildings shape and height, the façade towards the *Brailledreef* and the lateral facades would be subjected to road traffic noise levels higher than the preferred limit values, and the higher floors (above 10 meters) would also experience high noise levels due to rail traffic.

It therefore highlighted how, given the silent façade requirement for higher values exemption (see Subsection 8.2.2), residential towers would be difficult to realize, and a continuous elongated block would be preferable (see Figure 9.6b).

The same indication is then restated by the Noise report of 22nd June 2006 [U5], in which detailed results for the different noise levels for each façade are reported.

[210] Interview with the acoustic consultant in charge of the project, 3rd September 2018.

[211] Interview with the architect in charge of the project, 10th October 2018; Interview with planner of the local City planning Area involved in the project, 17th October 2018.

[212] On the contrary, the position of the school with respect to the roads and the different requirements on noise protections for schools, did not pose particular issues to the previous building.

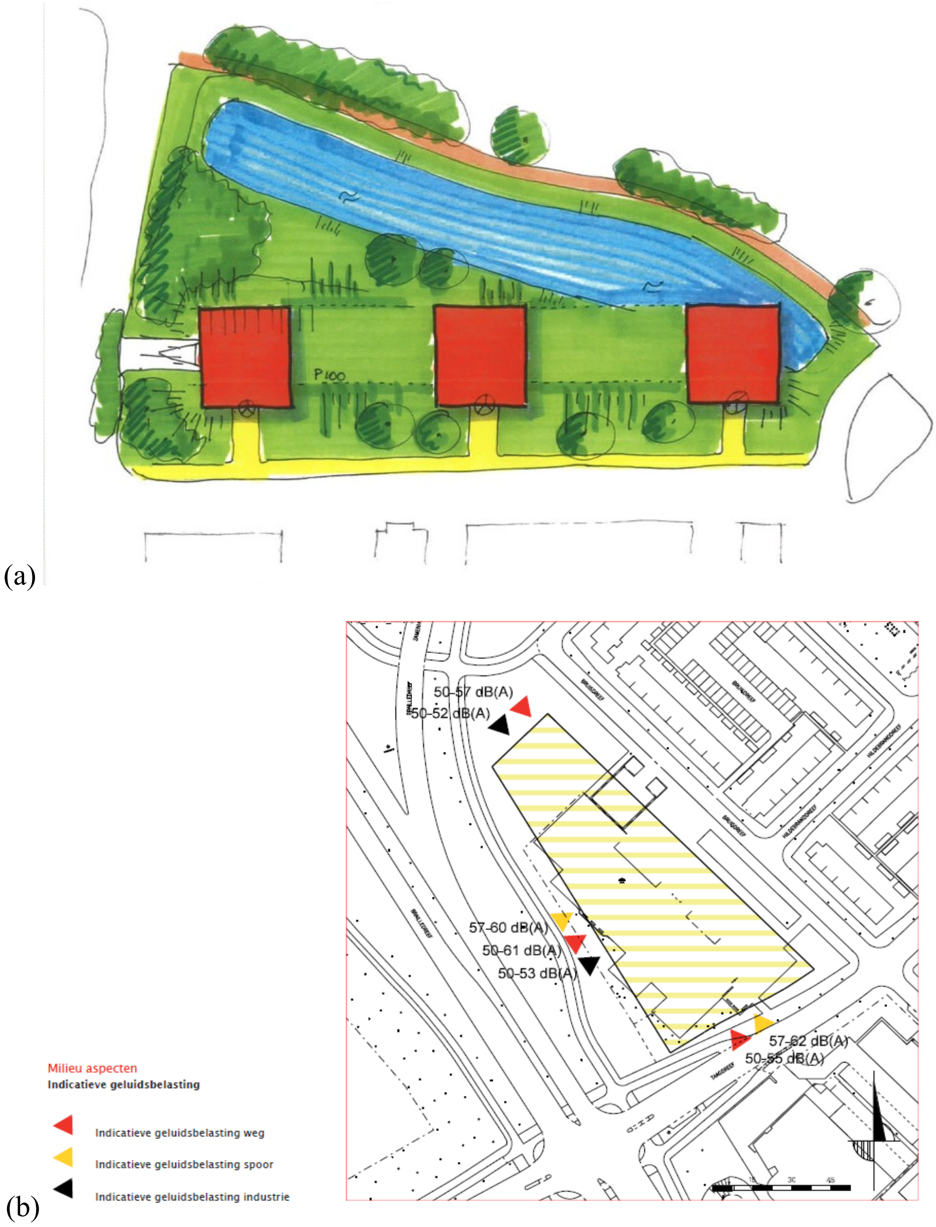


Figure 9.6 - (a) Sketch used as a reference for the first acoustic simulations; (b) general results of the calculations (from acoustic report of 22nd June 2006)

However, during a meeting conducted on 24th August 2006 [U6] between the proponents, the architect in charge of the project, the Environment area and the City Planning area of the municipality, the proposal was explicitly rejected as incompliant with the urban layout proposed by the Planning area, which had in the meanwhile adopted the *memorandum of principle* for the development of Overvecht-zuid district, in line with the more general guidelines of the *Overvecht vision 2004-2020*.

As pointed out by a planner of the local City planning area of the city of Utrecht, the need to keep the principles of the Sixties development both in terms of good sun orientation and distinction of the new buildings in the “green structure” with respect to the residential neighborhoods, led the municipality to choose a development made of “tower-like” buildings, in order also to keep the view to the outside of the area as clearer as possible for previous inhabitants[213].

The tower layout was chosen also in view of “the special location of the area, which is situated in a highly visible location in the entrance area of Overvecht-Zuid[…] where the higher buildings act as an eye-catcher”[214]

Moreover, according to the acoustic consultant, the contingent condition of the building market, as well as the will to realize both selling and renting apartments in the same plot, had a role in the choice of three separate buildings over an elongated, unique building[215]:

“The elongated building was a “no go area”, and it has to do with the market at the moment.. 2006-2007.. the market was going down in the Netherlands, so it was not easy to make large developments and they said <<we have to make the risk smaller, so we can’t make large buildings, so you have to make small buildings.. just for risk developments.. to make it more acceptable>>[…] And […] if you make one building with rent and buying apartments it is difficult in the position of the owner.. it’s easier to make them separate.”

Collective imagination related to certain building types and the desire to convey a certain image of the neighborhood, with its redevelopment, might also have played a role in the choice, as reported by the architect who was in charge of the project[216]:

“When you put a building, you can make one elongated “gallery” building, 5 floors, and everybody has a quiet side, and also the people who already live in the houses on the back have less noise. […] [but] a gallery is considered not so nice to live in, is more like social housing, because it’s cheaper. A gallery is 100 apartments, one elevator, and a staircase.. it’s cheaper, but it’s also a big scale, and you want to make in the city more small scale buildings.. parcels.. so that’s why you want to have 3 or 4 buildings, the smaller the better,.” (see Figure 9.7).

[213] Interview with planner of the local City planning Area involved in the project, 17th October 2018

[214] From the *memorandum of principles* of the Bruisdreef project (Nota van uitgangspunten), March 2008

[215] Interview with the acoustic consultant in charge of the project, 3rd September 2018

[216] Interview with the architect in charge of the project, 10th October 2018

(a)

(b)

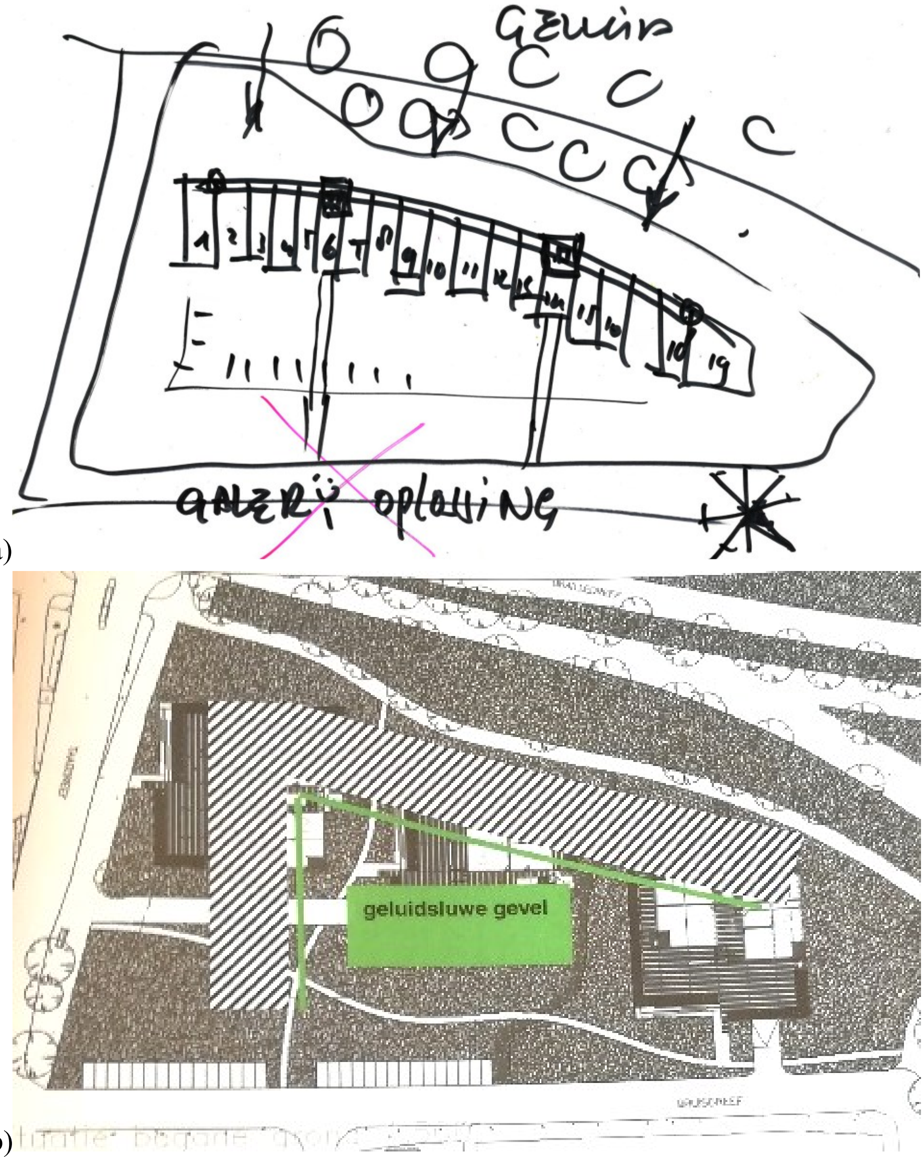


Figure 9.7 – (a) drawing produced by the architect to explain the concept of "gallery" building. Arrows in the upper part indicate the main direction of road traffic noise [=Geluid]; (b) "Possible building form for creating a low-noise façade" ad reported in the report from the acoustic consultant

As done with the Turin case-study (see Figure 6.9 and 6.11), Figure 9.8 shows a view of the debate around the choice of the building shape, together with the main actors involved.

As previously seen in Chapter 6 (see Figure 6.9), the *matter of concern* is identified by a red label on the let side of the map. The label is then connected to the actions performed to conduct the negotiation (grey labels) and each action in turn is connected to the network of human and non-human actors involved.

It can be seen that also in this case the debate is link to many different actors, which go beyond the acoustic ones. In particular, the proposal of the elongated "gallery" building from the acoustic consultant and the Environment area (blue labels) is linked, as could be expected, to noise mitigation laws and provincial policies, that enter in the process by requiring a silent façade (violet and purple label) and to noise data from calculations that exceed the limit values (yellow label).

In particular, since the debate took place before the legislatve modifications of 2007, the two national implementing decrees setting the preferred limits value and the province policies setting the requirements for higher values exemptions are involved (see Chapter 8).

On the other side, the proposal is opposed by the proponent (blue label), due mainly to building market necessities (light blue labels and dark green label), and most of all by the local Planning area, as the proposal is in contrast with the local policies for the area (light green labels) and the image of the Overvecth district they want to carry through with its renovation (dark green labels).

The map shows, also in this case, the concerns that constitute the “cosmos” of the different actors (Venturini 2012), visualizing on a real case study the different “framework of interpretation” introduced in Chapter 2.

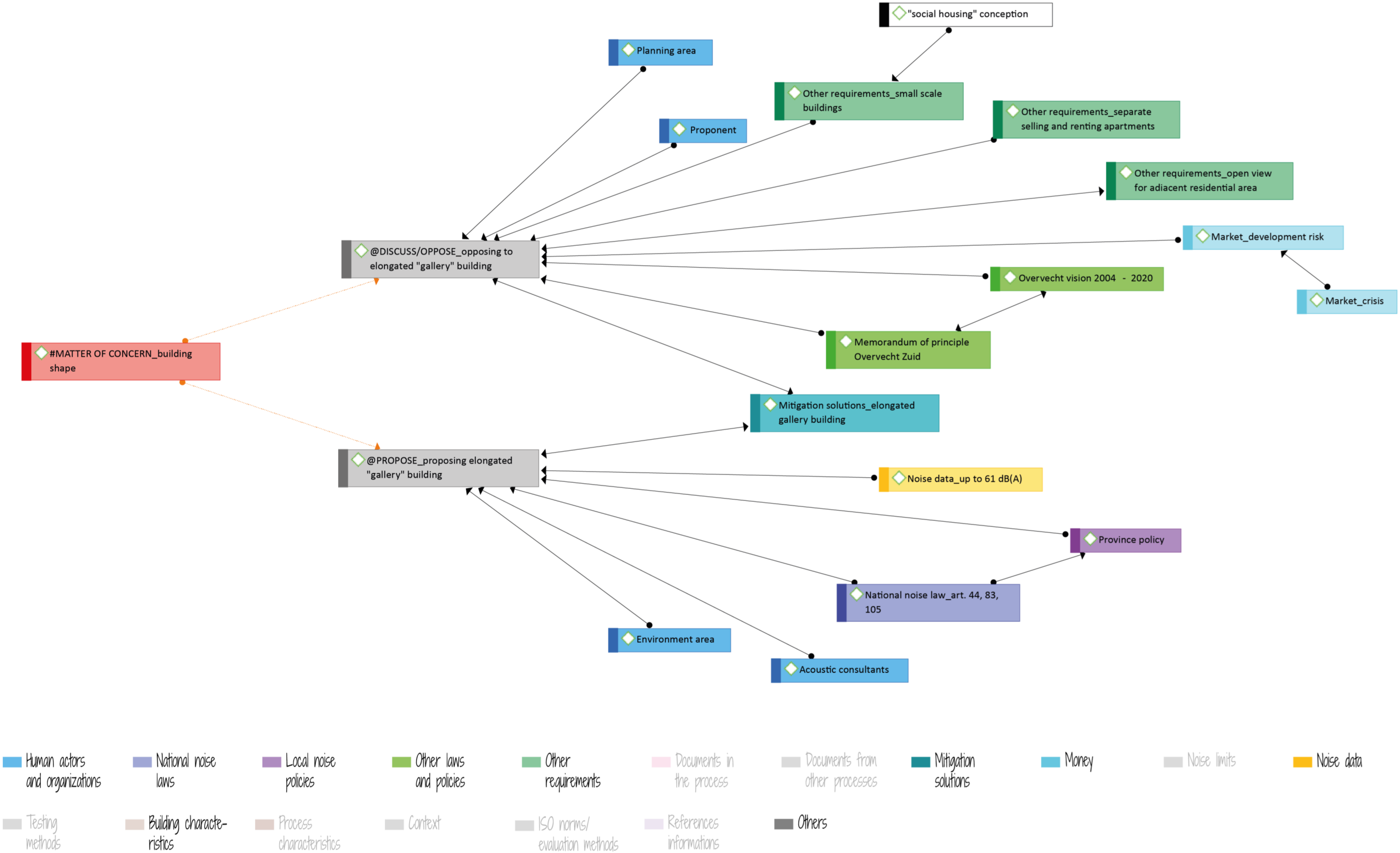


Figure 9.8 - A view of the debate around the Matter of concern of building shape

In this first debate, therefore, noise mitigation requirements are not *translated* into the project, as there is a majority of reasons in support of the “tower-like” plan.

Figure 9.13 uses the “concern” map (see Subsection 4.3.2) to visualize the *matters of concern* developed during the first project, showing the involved actors and the material effects on the project. As can be seen in the map, no modifications to the building are done during the *matter of concern* on the building shape, as the design proposed to obtain silent facades is not integrated.

This would lead, as can be expected, to the necessity of taking further measures in order to satisfy the requirements to obtain the granting of higher values exemption, and therefore to further effects on the design of the buildings.

9.3.2 Setting the details: on balconies and plans layout

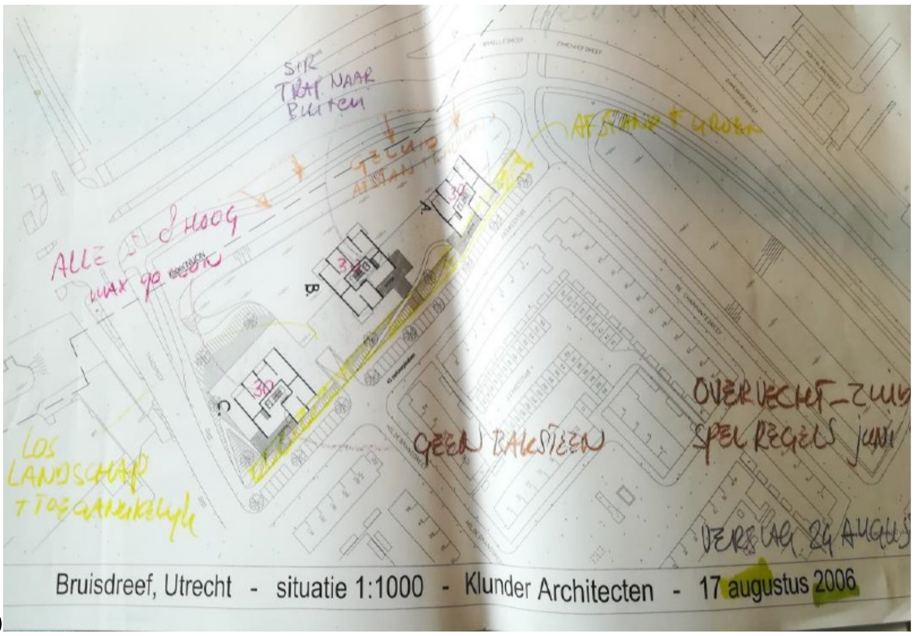
The first controversies that raised right after the meeting in August 2006, consequently to the choice of tower-like buildings, was the one on balconies position. Drawings from the architects, probably presented during the meeting between proponent, architect and acoustic consultant on 8th September 2006 [U7] showed proposals with three to four apartments per floor, two of which have the balcony towards the road.

As explained by both the architect and the acoustic consultant involved in the project[217], the first choice of balconies position was due to the need of good sun exposure for outdoor areas, particularly valued in the Dutch climate, being the road side oriented in south-east direction. However, Province policies requirements for silent outdoor spaces (see Subsection 8.2.2) as explained by the architect:

“We cannot make the balcony here [towards the road]. Otherwise it must be a closed balcony, that we called a serra.. so you have a window [in the “serra”]. But if you put a window open, or you put the door open, the noise gets in. But yes, [in Utrecht] they want to have it open”

Hence, south-oriented “serras” [=verandas] could not be considered as a solution for outdoor quiet spaces, due to Province requirements for outdoor quiet spaces, that forbid to use completely closable screens to solve the noise mitigation issues, and required a part of the balcony to be left completely open. In October 2006 [U8] the design proposed in September was therefore opposed by the acoustic consultant, due to the local guidelines requests.

[217] Interview with the acoustic consultant in charge of the project, 3rd September 2018; Interview with the architect in charge of the project, 10th October 2018

(a)


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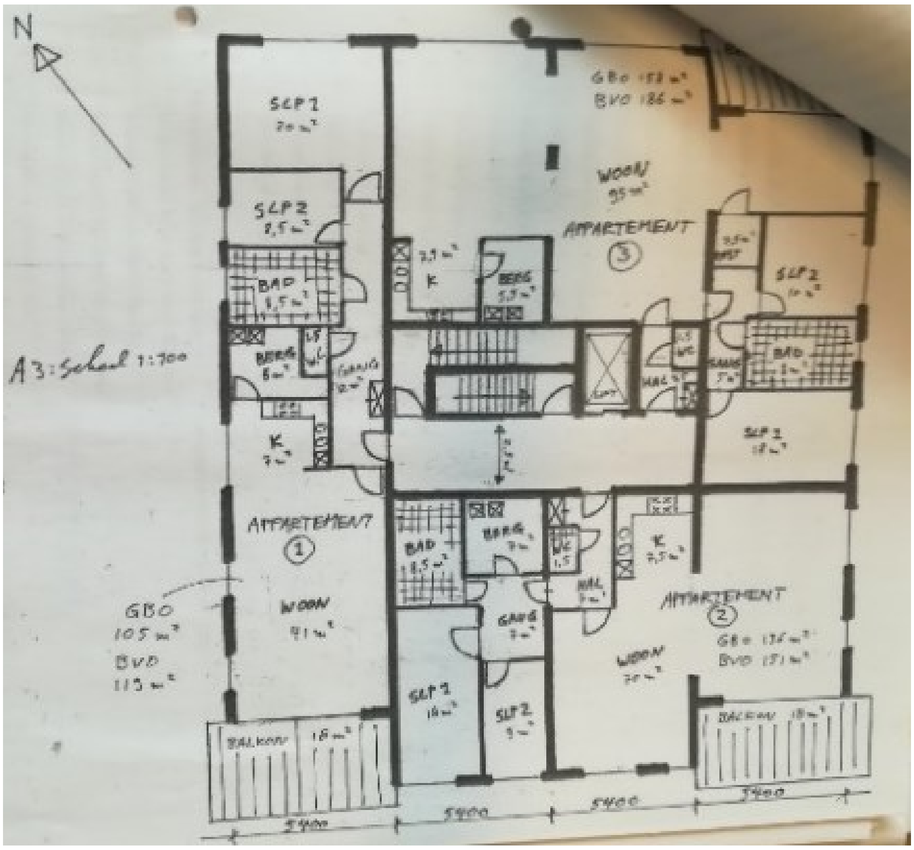

Figure 9.9 - (a)drawing with the three towers showing balconies facing the busy street side; (b) detail of the plan of a tower.

Figure 9.11 shows a network visualization of the debate around balconies position, as derived from Atlas.ti analysis of interviews and documents. As can be seen in the picture, a role in the debate has also the providing of evidence in the discussion between architect and acoustic consultant, through the use of drawings visualizing the noise issue (see Figure 9.10). As pointed out by the acoustic consultant[218]:

And we always made this kind of drawing to make things… acceptable for people, that they understand what is happening. […] just to explain them how things work and what we have to do. This are thing we made.. sketching with the architects.. so red is the high noise level, orange is still above preferred value but only up to 5 dB higher, and blue is fine.

It's very… very common to.. look different into the 5 dB above legislation.. because the first five is always easier than the next one. that's the interesting part because it's.. convincing the developer and the architect and looking into measures there."

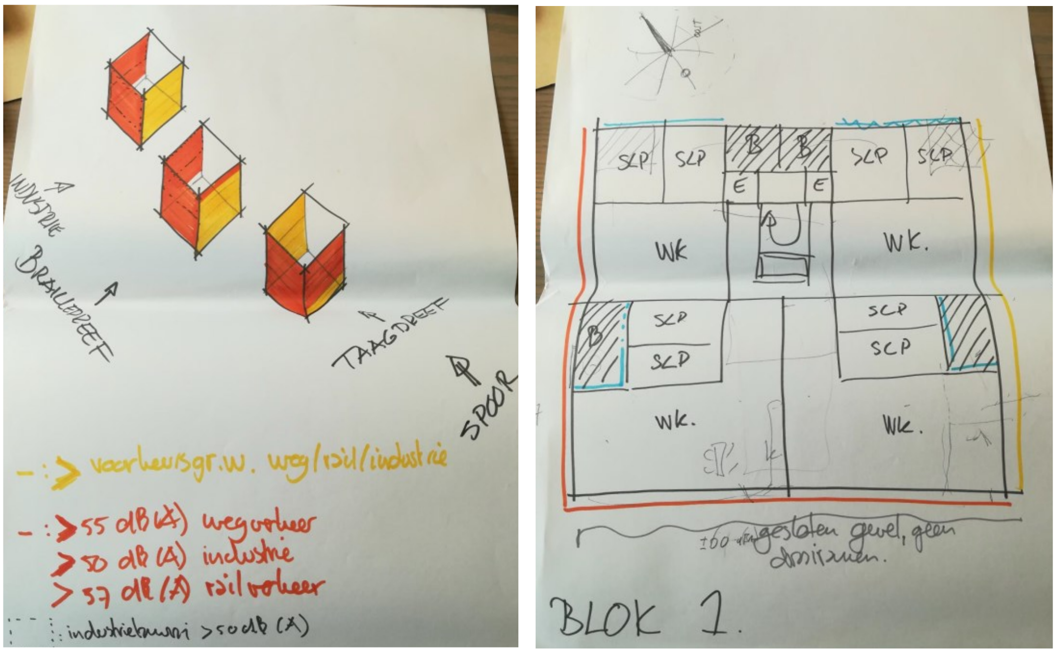

Figure 9.10 – images of the drawings provided by the acoustic consultants, developed during the discussion with the architect on the positioning of balconies

[218] Interview conducted on 2nd October 2018

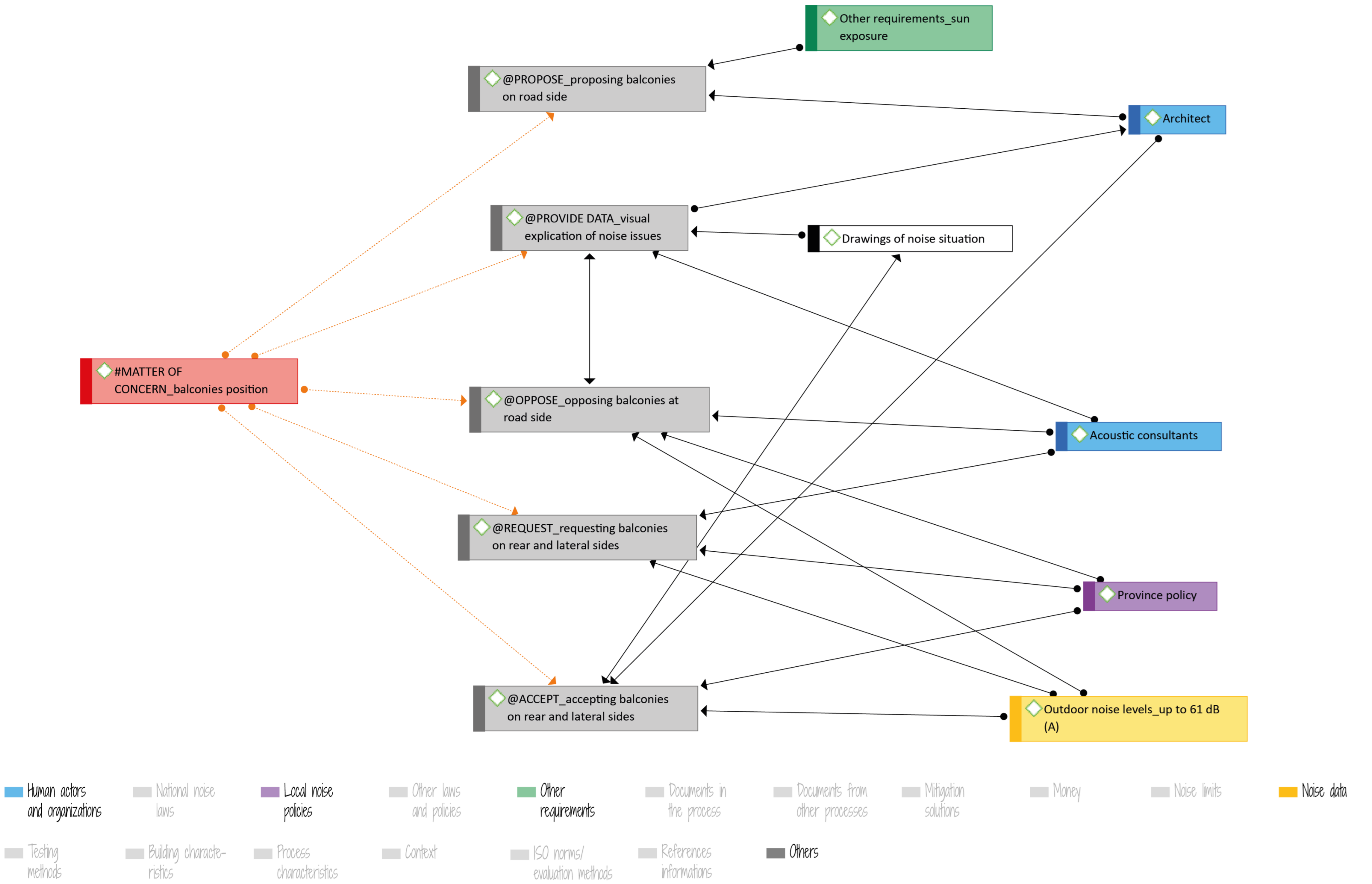

Figure 9.11 – View of the debate around the *Matter of concern* of balconies position

As can be seen in Figure 9.11, a small network of actors is involved in the controversy. In particular, the proposal of open balconies oriented towards the road side, due to the will to find the better sun exposure for the balconies (green label), wan opposed due to the requirements of province policies (purple label), which set specific indications for outdoor spaces, which in turn are due to the high noise levels to which the buildings are exposed on the side facing the *Brailledreef* road (yellow label). Therefore, the province policies are, together with the noise levels calculated at the facades facing the road, the only non-human actor needed to make the architect and the proponent accept to change the buildings orientation, although the communication through drawing supported this acceptance. Moreover, it can be seen in the Figure that neither the local Environment area nor the Province offices are involved in the controversy.

In this case, therefore, **the policies acted on their behalf in enrolling designers in the translation of desired mitigations into the project**, as underlined by Rydin (Rydin 2013) (see Subsection 2.2.1), due to their level of detail in the indication they give in term of building design.

Drawings from the architects dated 9th November 2006 [U9] showed plans of the buildings with balconies on the silent side and partially enclosed, hence showing a closure of the controversy with a translation of the noise mitigation requirements, set by the Province policies.

Such drawings were considered as a good solution in terms of plans layout and balconies design by the acoustic consultant, since they allowed to obtain the silent façade requested by the province policies on one side of the balcony (see Figure 9.12a), a well as to provide all the rooms with access to outdoor space. However, drawings dated 22nd January 2007 [U11] reported a new layout.

Due to modifications in the overall building structure, which was tied to the prefabricated building structure, the layout of the flats needed to be changed, as the two flats on the sides of the staircase resulted to be too small. Therefore, a double bedroom was added to the flat. Such bedroom was provided with a French window on the balcony side facing the silent façade (see Figure 9.12).

However, this was contested in the report by the acoustic consultant on 7th February 2007 [U12], as the glass on the opposite side of the silent façade caused reflections of the noise coming from the road, hence impeding to reach the desired noise abatement at the silent façade, requested by the local noise policies which had in the meantime entered into force (23rd January 2007). A blind façade with sound absorbing upholstery was instead suggested.

The controversy was then interrupted, since the project was completely changed after the withdrawal of one of the proponents, and acoustic evaluations on the new project were started from scratch in 2009, when drawings of the new project were sent to the acoustic consultant [U13] (see Figure 9.13).

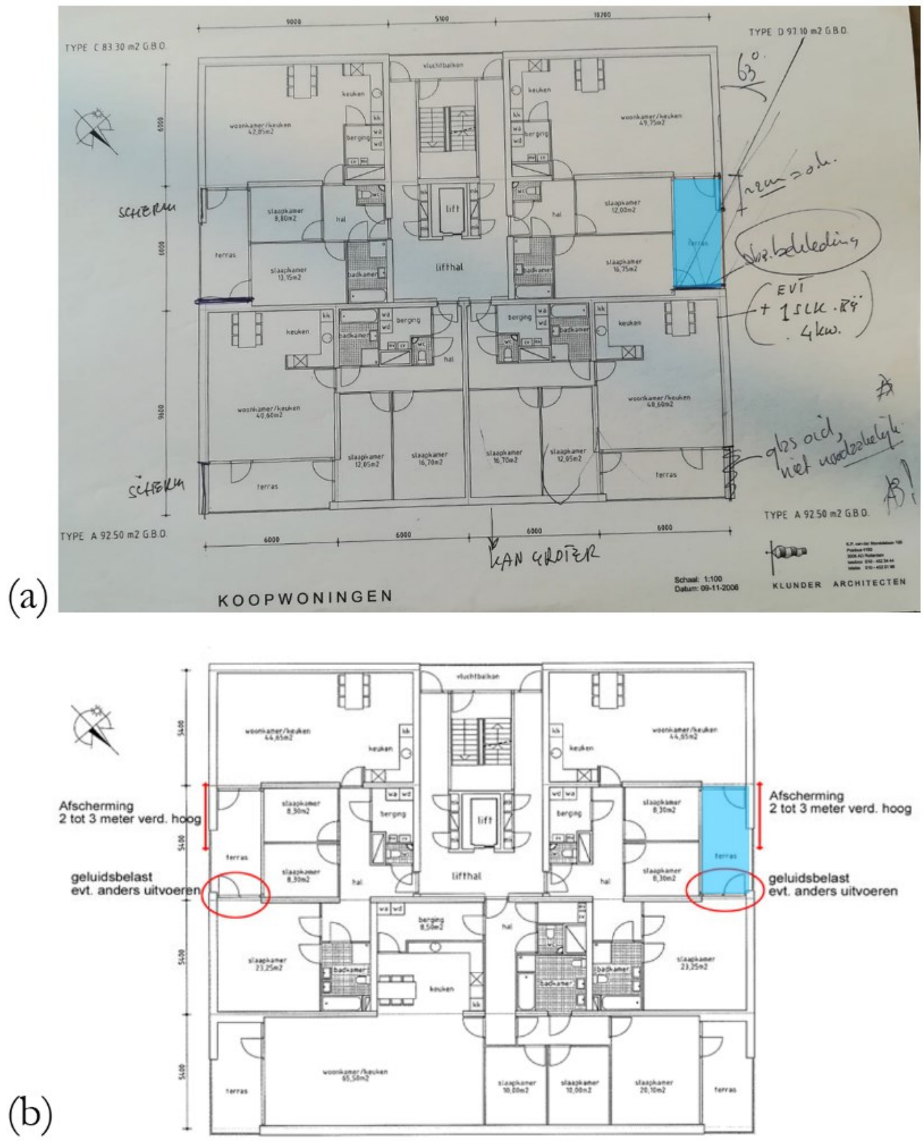

Figure 9.12 – (a) drawings 9th November 2006, with schemes from the acoustic consultant indicating the position of the sound absorbing façade; (b) drawings reported on acoustic environment report on 7th February 2007, with indications of the French windows that should be substituted by sound absorbing material. (balconies are indicated with light blue for reference).

Figure 9.13 uses the "concern" map layout, as defined in Chapter 4, in order to show the development in time of the three *matter of concern* emerged during the first project, in 2006-2007.

The three *matter of concern,* namely "building shape", "balconies position" and "balconies design" are listed in the map and represented by grey bars that indicate their duration in time. Under each *matter of concern*, the proposed solutions are listed. The symbols along the line of each solutions indicate the time in which each solution was proposed (black arrows), accepted (green tick) or contested (red X). As already seen for the Turin case-study, the table on the right allow to see, for each of the proposed solutions, what kind of non-human actors contributed to its proposal, acceptance or discard. Finally, in the lower part of the map are shown the material changes of the building brought by such concerns ("effect" part of the map).

By looking at the map in Figure 9.13 it can be seen how in this phase of the project the only successful acceptance of noise mitigation solutions (green tick) was in the case of the "balconies position" concern, in which balconies placed on rear and lateral side of the building were proposed by the acoustic consultant due to the requirement of province policies (purple column in the "non-human actors" table) and to the high noise levels to which the façade of the building on the road side is exposed (yellow column). Such solution was then accepted, given the requirements of province policies, as already explained in this subsection.

It can be seen therefore how, while in the controversy on building shape no mitigation measure was added to the project, in the case of balconies position the province policies act in steering the refusal of one option (red cross mark on "serras on road side") and the choice of the other (green tick mark on "balconies on rear and lateral side"). The closure of this controversy with the acceptance of the modified balconies position leaded to the first change in the building design due to noise mitigation issues, as can be seen in the lower part of the map, "effect" section.

As put in light in this subsection and in Subsection 9.3.1, other non-noise related requirements and policies prevailed on the noise mitigation requirements in the *matter of concern* on building shape, as no strict indications are provided by the noise policies on this aspect. On the other hand, in the *matter of concern* related to balconies position, **the local noise policies leaded to the acceptance of the mitigation solution at the expenses of other requirements, given the more precise and binding prescriptions they provided**.

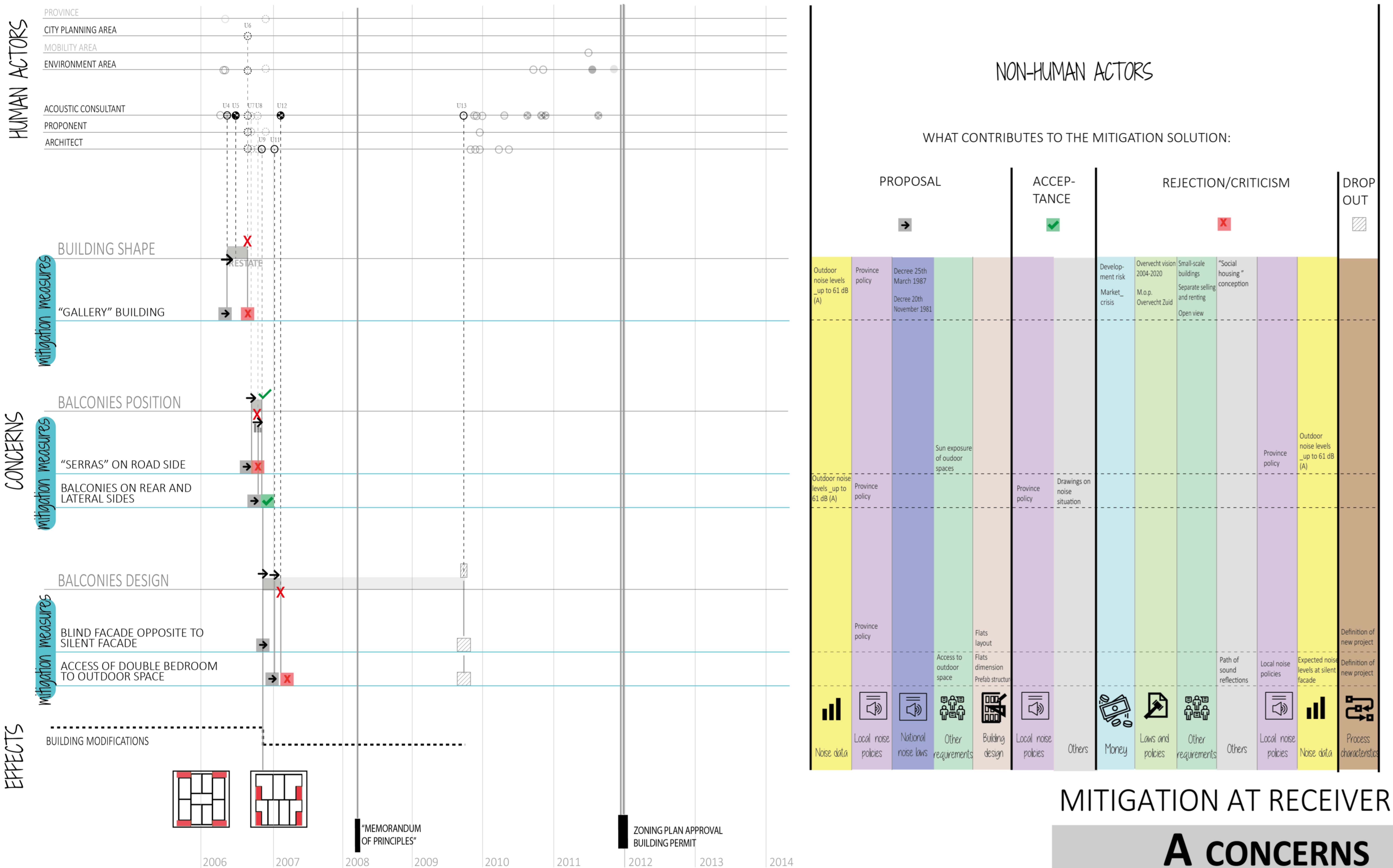

Figure 9.13 – "concerns" map exploring the *matters of concern* emerged during the first project.

9.3.3 Discussing the new buildings layout

In Autumn 2009, new acoustic evaluations and consequent design modifications were started for the new project, which was being defined consequently to the withdrawal of one of the proponents and the crisis in the building market (see Section 9.1).

The drawings initially sent to the acoustic consultant for the evaluation, dated July 2009 [U13], had balconies located on the quiet sides, as requested for the previous project in 2006. However, the project was modified in November 2009 [U14] by "turning" the towers in order to provide a more open view towards the outskirt of the neighbourhood for the pre-existent houses, following an observation made by local resident after the publication of the *Memorandum of principle* in March 2008[219]. However, the initial layout of the building floors was kept unvaried, hence resulting in new issues on the position of balconies. The memorandum sent to the developers by the acoustic consultant on 16th November 2009 [U15], underlined how

If you choose to keep the orientation and layout of the building blocks and apartments this way, [...], a reduction of 13 dB is required. This means a fully enclosed glass space equipped with natural ventilation facilities (grids)[220].

However, this was not in line with the local noise policies, in force since January 2007, which had inherited the request of province policies to provide permanent openings for the outdoor spaces, in order to be considered as such.

Figure 9.14 shows a comparison between the layout proposed in July 2009 (a) and the one proposed in November 2009, with the indications of high noise levels reported by the *memorandum* of 16th November 2009 (b).

The same memorandum tried to propose again the use of an elongated, unique building. However, the proposal was rejected for the same reasons that were raised at the beginning of the process in 2006, and the drawings of 23rd November 2009 [U16] still kept the 3 towers layout.

The balconies were however moved on the rear and lateral sides, as suggested by the acoustic consultants. Only one balcony was initially left on the road side (block A in Figure 9.15), as a tentative to keep the same layout for all the buildings[221].

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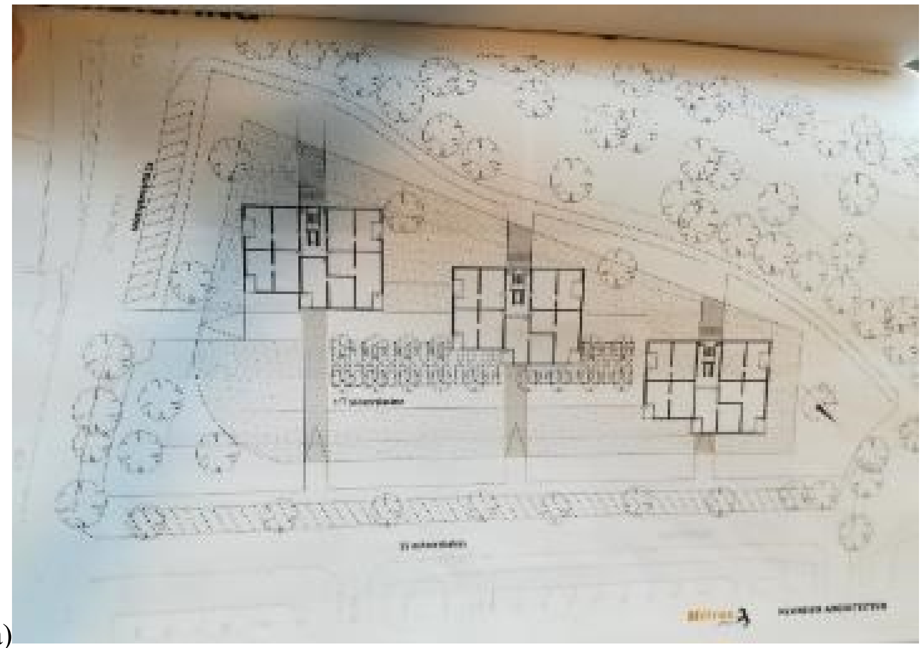
[219] Interview with the project manager from the local City planning area in charge of the project, conducted on 7th November 2018

[220] In the original: *indien er wordt gekozen de orientatie en indeling van de bouwblokken en de appartamenten zo te houden [...] is er een reductie nodig van 13 dB. dit betekend dan een volledig gesloten glazen ruimte voorzien van natuurlijke ventilatievoorzeningen (roosters)*

[221] Interview with the architect in charge of the project, 10th October 2018

(a)


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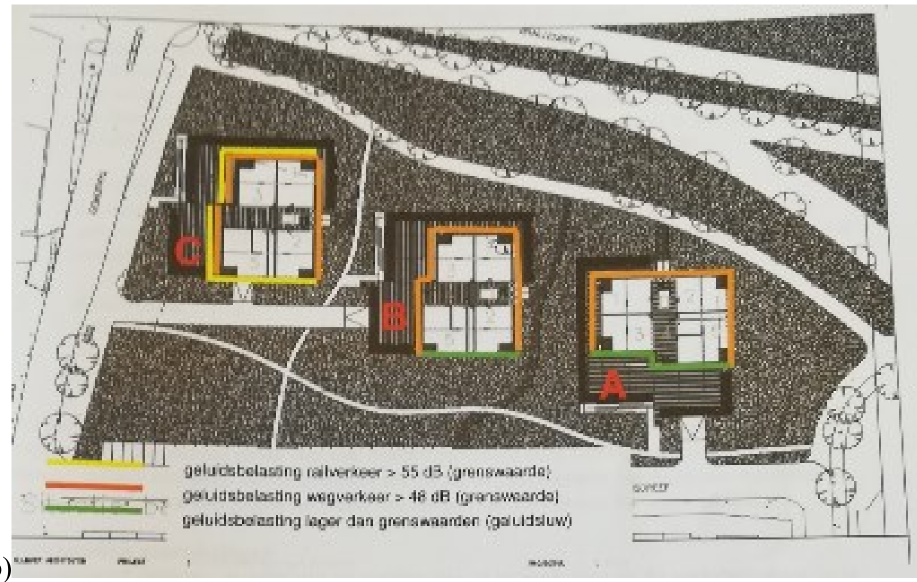
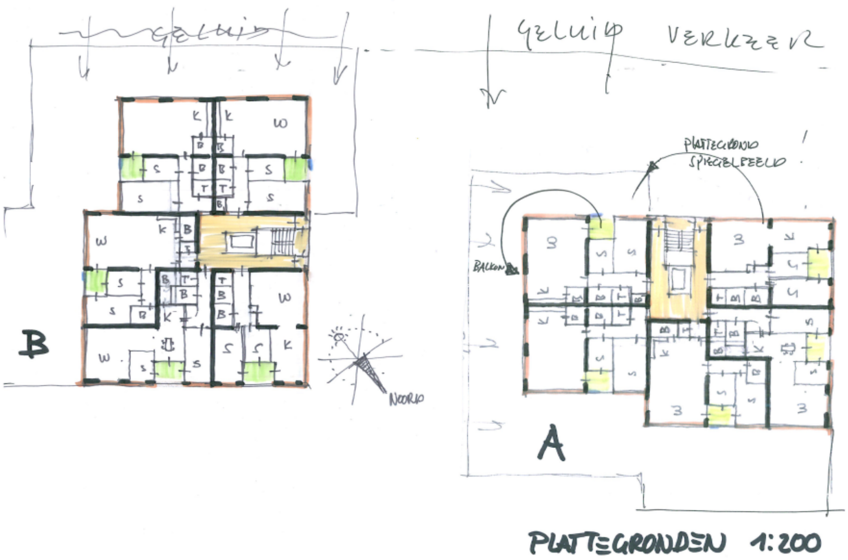


Figure 9.14- (a) building plans in July 2009; (b) building plans in November 2009, with the indication of the noise levels beyond preferred values, as reported in the acoustic *memorandum* dated 16th November 2009

The drawings were however corrected shortly after, in response to a new request from the acoustic consultant [U17], as the local guidelines specified that outdoor quiet spaces could not be designed as completely closed "serras", but permanent openings should be present in the balcony screening. In this case, the noise levels and the position of the buildings with respect to noise source did not allow to have balconies with proper openings facing the road (see Figure 9.18a).

(a)



(b)

Figure 9.15 – drawings presented on November 2009 by the architect, with indications for the correction of the position of the balcony in Block A

In the same communication, dated 7th December 2009 [U17], the acoustic consultant also requested a modification of balconies depth, as the design proposed by the architect was not enough to satisfy the requests of local guidelines, set by the local Environment area in order to set practical indications on how to implement the requests of the local noise guidelines through the building design (see Subsection 8.2.2). The guidelines in force at the time specified indeed that the silent façade requested by the local noise policies should be at least 1.8 m wide in order to be considered as so and hence being accepted as a requisite for higher values exemption. The communication specified indeed that *in each flat 1 part (window or door) that can be opened is required in the silent facade [...] this facade is at least 1.8 m wide (balcony depth*).

On 14th December 2009 new plans [U18], which featured deeper balconies, were sent to the acoustic consultants. The mail that accompanied the drawings reported that

The location of the balcony is desired on the silent side of the apartment. This principle has now been implemented

And

"the living areas are all linked to the loggias, in connection with the noise levels."

in order to provide to all the rooms with an opening towards the quiet outdoor space (see Figure 9.16).

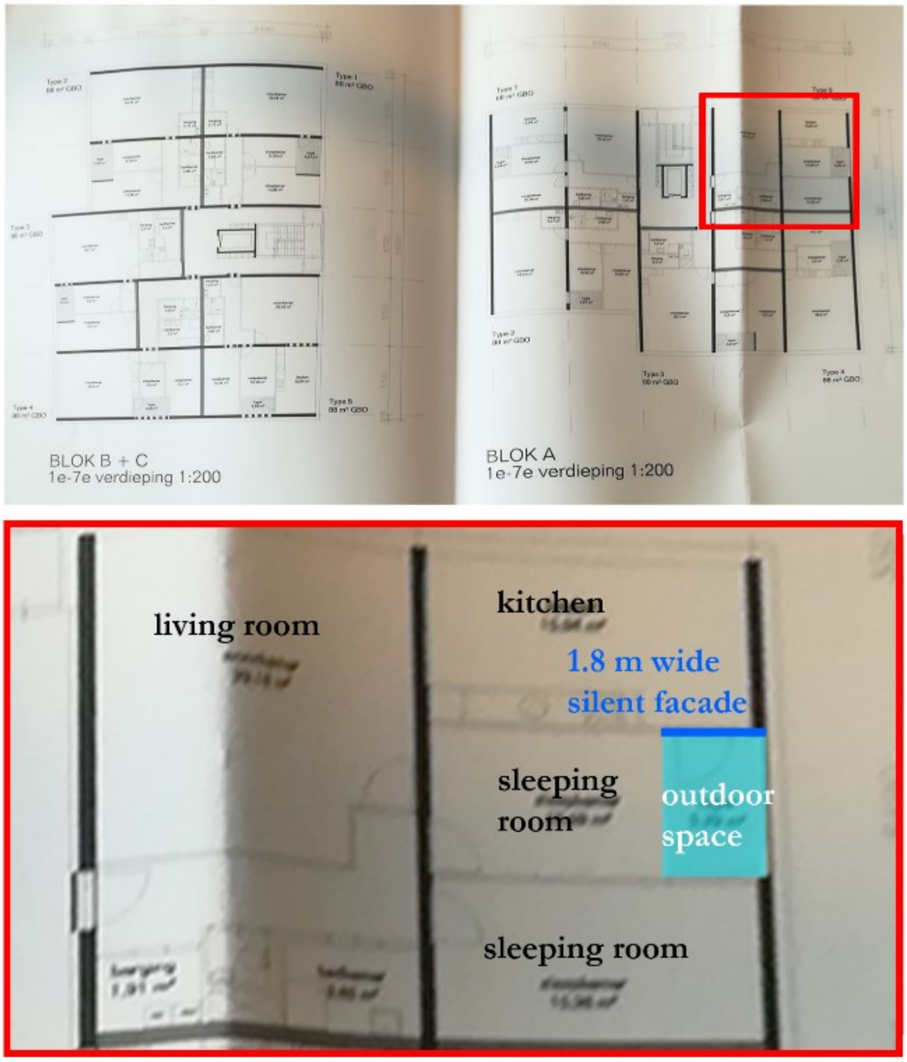


Figure 9.16 – floor plans on 14th December 2009. The zoom marked in red focus on one flat, indicating the quiet outdoor space (light blue area), and the silent façade (blue line) towards which the living room is faced (elaboration of the author on drawings provided by the acoustic consultant.

The following response of the acoustic consultant to such drawings, dated 18th December 2009 [U19], while indicating the flats layout as "optimal", underlined how extra screening was needed in the balconies on lateral sides, since, due to the direction of the noise coming from the *Brailledreef* road, the noise levels on the silent facades of those balconies were still above the preferred levels.

The email suggested to solve the problem

"for example, by hanging a glass screen construction vertically in front of the silent façade, at a distance of approximately 10 cm, with, for example, a tilting construction to be opened, directed upwards [in order to provide the requested natural ventilation, while still granting the needed 10 dB reduction at the window behind the screen]. […] to achieve the 10 dB reduction without closing off the entire loggia."[222] (see Figure 9.17b)

This suggestion was not integrated by the architect into the drawing, as it would have leaded to the impossibility of reaching the quiet outdoor space from the living room, while also reducing the usable space on the balcony, hence reducing its liveability[223].

In April 2010, new drawings [U20] answered to the request with a different solutions, that also enhance the liveability of outdoor spaces. Balconies were enlarged, so as to provide a wider outdoor pace for each flat, as well as allowing the mounting of an extra screen to shield the balcony from noise coming from the road (see figure 9.17a).

The *memorandum* of 21st April 2010 [U21] from the acoustic consultants approved the proposed balcony design, but added the request of closing the access of one of the sleeping rooms to the outdoor space (see the door indicated in the zoom on the right part of Figure 9.17a), as a sound absorbing façade was needed on the side facing the silent facade, in order to reduce reflections of the noise coming from the road and reach the preferred value at the silent façade (see Figure 9.17c).

Drawings dated 11th May 2010 [U22] reported then this last modification, hence closing the *matter of concern* on balconies design (see Figure 9.18b).

The same drawings also closed another *matter of concern,* related to floor layout. The drawings presented in April 2010 [U20], indeed, although presenting a layout that, as already stated in December 2009, allowed to provide all the rooms with an access to the balcony, still presented a problem with respect to noise mitigation policies, especially in the plans of block A.

The *memorandum* of the acoustic consultants of 21st April 2010 [U21] then suggested an inversion between living and sleeping areas, reporting that

"This is due to the saleability of the houses"

---

[222] In the original: *bijvoorbeeld door vertikaal voor de loggia-gevelinkeping een glazen schermconstructie aan de gevel te hangen (op circa 10 cm aftand rondom, met bijvoorbeeld een kiepconstructie waardoor het te openene deel van de constructie naar boven is gericht) [...] om de 10 dB reductie te hale zonder de hele loggia af te sluiten.*

[223] Email exchange with the architect, 28th October 2018

And that .

"Although this is not preferred (bedroom windows to be opened on noise-exposed facade), this change complies with the principles for a higher value exemption of the Municipality of Utrecht."[224]

Indeed, although all the sleeping room faced the outdoor space, the room actually bordering the only side that could be counted as silent façade was a sleeping room that did not satisfy the requirements set by the local noise guidelines, which required that 30% of the rooms or of the floor area bordered the silent façade (see Subsection 8.2.2).

The requested changes were then applied in the drawings of 11th May 2010 [U22], as said before, closing the *Matter of concern* related to floor layout (see Figure 9.18b).

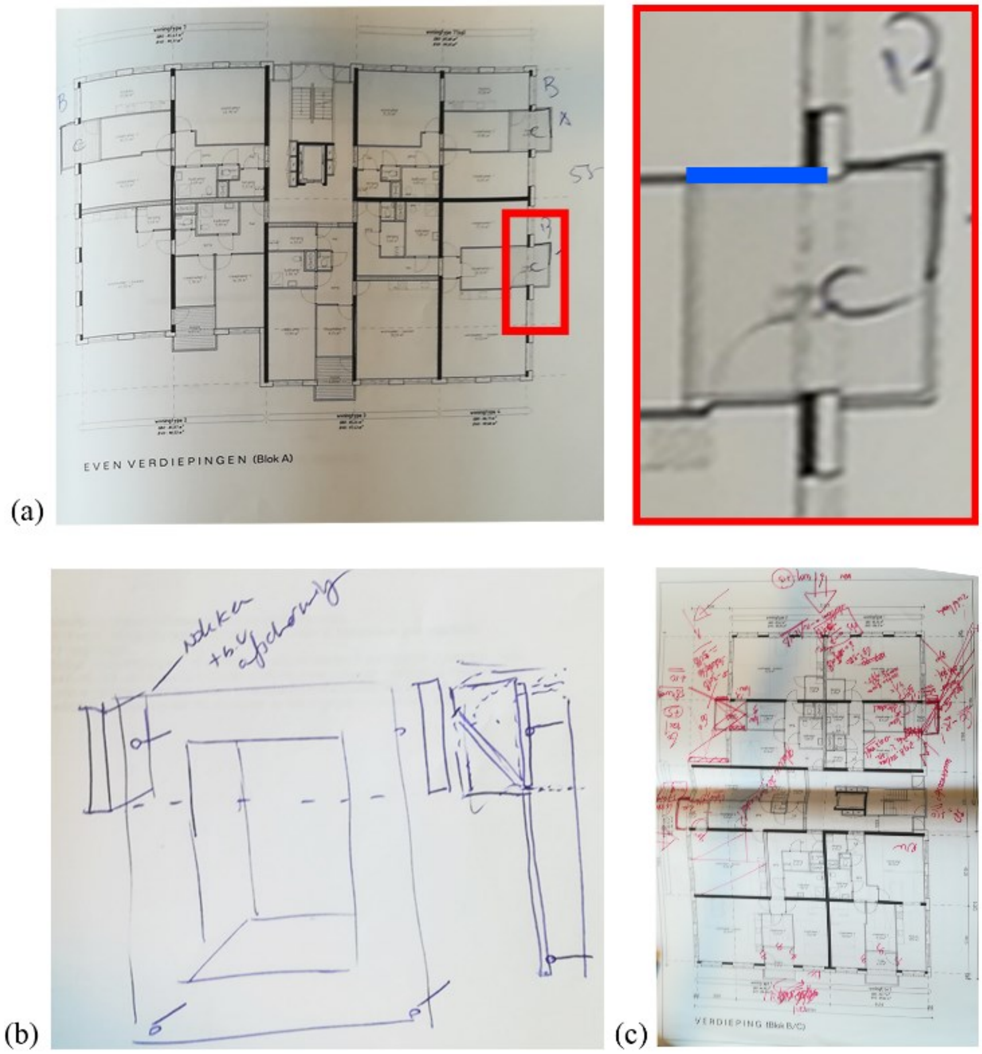


Figure 9.17- (a) plans of the buildings in March 2010. In the zoom it is shown an hand-drawn indication of the additional screen marked as "B" by the architect. Blue line on the silent façade has been added by the author as

[224] In the original: *Dit in verband met de verkoopbaarheld van de woningen. Hoevel dit niet de voorkeur heft (te openen slaapkammerramen op geluidsbelaste gevel) voldoet deze wijziging aan de uitgangspunten voor een hogere waarde van de Gemeente Utrecht.*

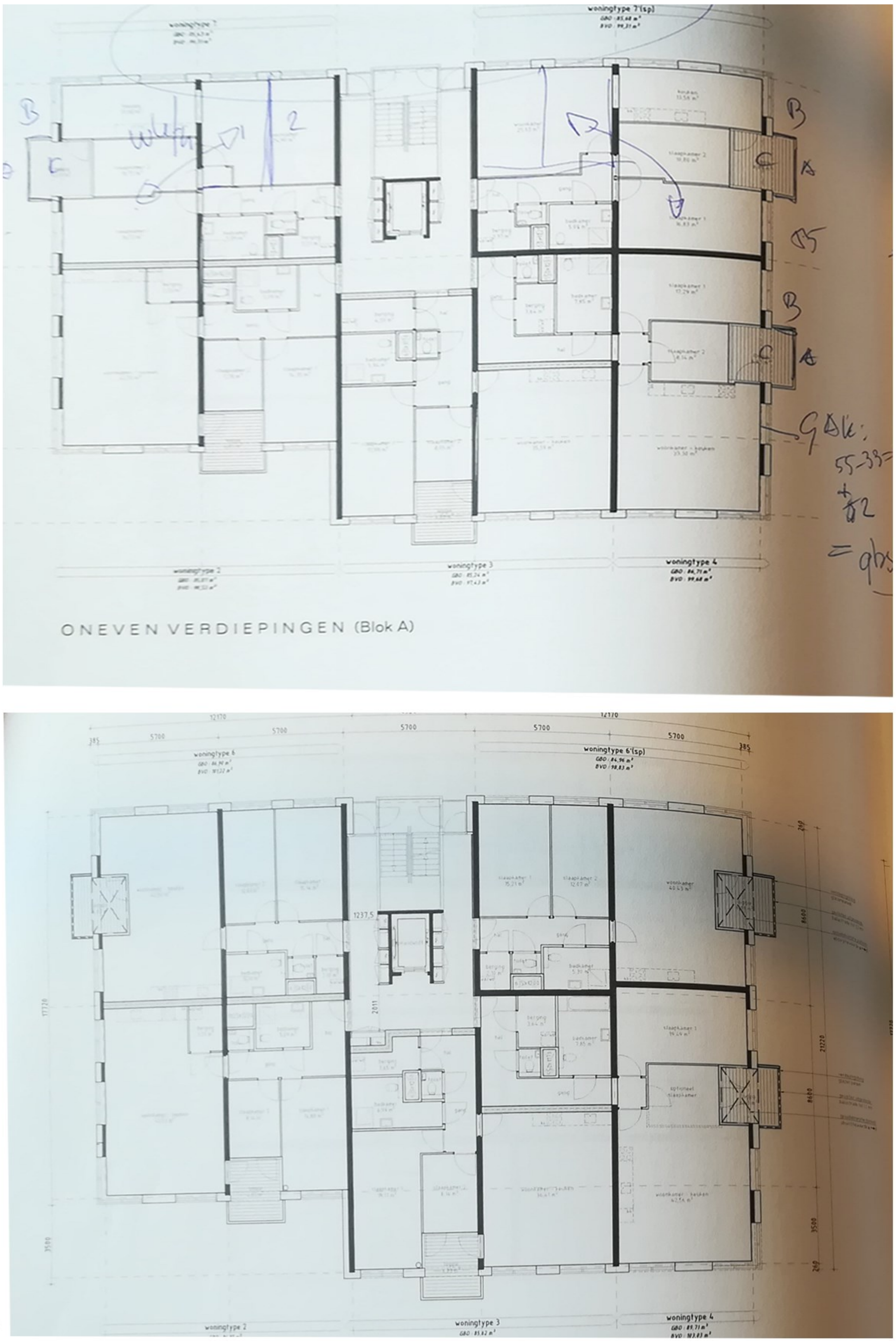
reference (b) hand drawing of the screen initially proposed by the acoustic consultant, attached to the email of 18th December 2009; (c) hand sketches of the acoustic consultants made on the plans of March 2010, in order to show the sound reflection paths and the need to provide ad absorbing façade in front of the silent one

Form the explorations of the *Matter of concern* related to balconies design and to floor layout and their material effects on the project, it is shown then how the requests of local policies and guidelines are satisfied by organizing the plans so that a silent façade that respects the minimum requirements of the local guidelines (1.8 m width) applies to a space that is big enough to satisfy the request, reported in the local noise policies, of having at least 30% of the flat facing the silent side.

As commented by one of the employees of the Environment Area who was involved in the process[225]:

"We say that in a silent side, the size should be a minimum of 1.80 m by 2.70 m, and this is absolute, absolute minimum.. so this is 1,80 and then we say, the living room [in this project] has a silent façade, so the whole living room counts for the 30% that has a silent façade… so we are not always that strict".

[225] Interview conducted on 17th October 2018



(a)

(b)

Figure 9.18 – (a) plans of the block A of the project in the March 2010 drawings, with pen annotations of the acoustic consultant, suggesting the shift in living rooms and bedrooms position; (b) plans of the same block in May 2010 drawings, showing the modification of the rooms layout.

Figure 9.19 uses the “concern” map to examine the *matters of concern* related to mitigation solutions at receiver emerged during the development of the new project, starting from late 2009.

By looking at the maps, it can be seen that, as in most of the previous concerns (see Figure 9.13), all the *matter of concern* involved only exchanges between proponent, architect and acoustic consultant. Hence no discussions were held with the local offices. Therefore, also in this case, **the local policies and guidelines acted “on behalf” of the offices that emitted it,** allowing them to **reach a control**

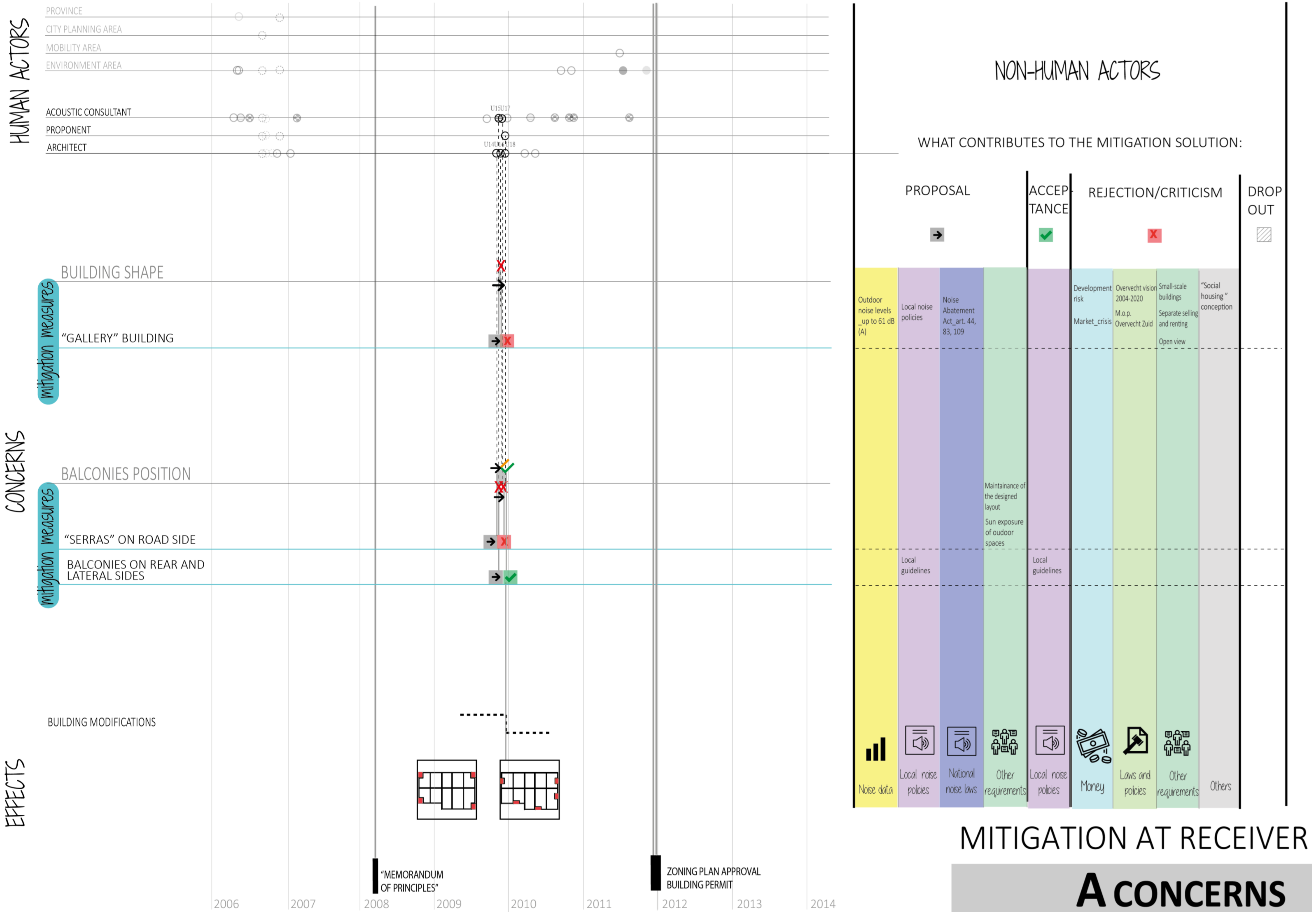
at distance on the design of the building and the integration of noise mitigation solutions into it, by bringing together the key actors for the design (architect and acoustic consultant (See Subsection 2.2.1).

Indeed, by looking at the tables on the right side of the maps ("non-human actors" section), it can be seen that in every *matter of concern*, almost all the acceptance of mitigation solutions (green ticks), are due to local noise policies and guidelines (purple columns in the table). However, **where the policies did not fix too strict requirements in terms of building design, a kind of negotiation** happened on possible mitigation solutions. That **allowed to reach a solution which could answer to noise mitigation requirements while still responding to other requirements**. It is the case of screens on the balcony (third and fourth solution proposed for the "balconies design" *matter of concern*), in which the architect refused the suggestion of the acoustic consultant to propose a solution that could better integrate noise mitigation with livability of outdoor spaces (green column).

On the other hand, **when local noise policies or guidelines defined specific rules for the building design, the concern was rapidly closed by the simple acceptance of the rule.** This is the case, for example, of the 1.8 m depth of the silent façade (third solution proposed for the "balconies design" *matter of concern*), or of the living room facing silent façade (second solution proposed for the "indoor layout" *matter of concern*) due to the 30% rule of the noise guidelines (See Subsection 8.2.2).

This supports what put in light by Bradbury (2016), who underlined that **true mediation of different actors' goals can only happen when there is a certain degree of flexibility in the regulations** and that when this happen, architect can gain an important role as mediators between different requirements (See Subsection 2.2.1).

Finally, by looking at the "effects" part of the map, it is possible to see how each acceptance of the different mitigation solutions (green ticks) leaded to a modification of the building design, resulting in a sequence of modifications within a short period of time (late 2009 up to May 2010).



MITIGATION AT RECEIVER

A CONCERNS

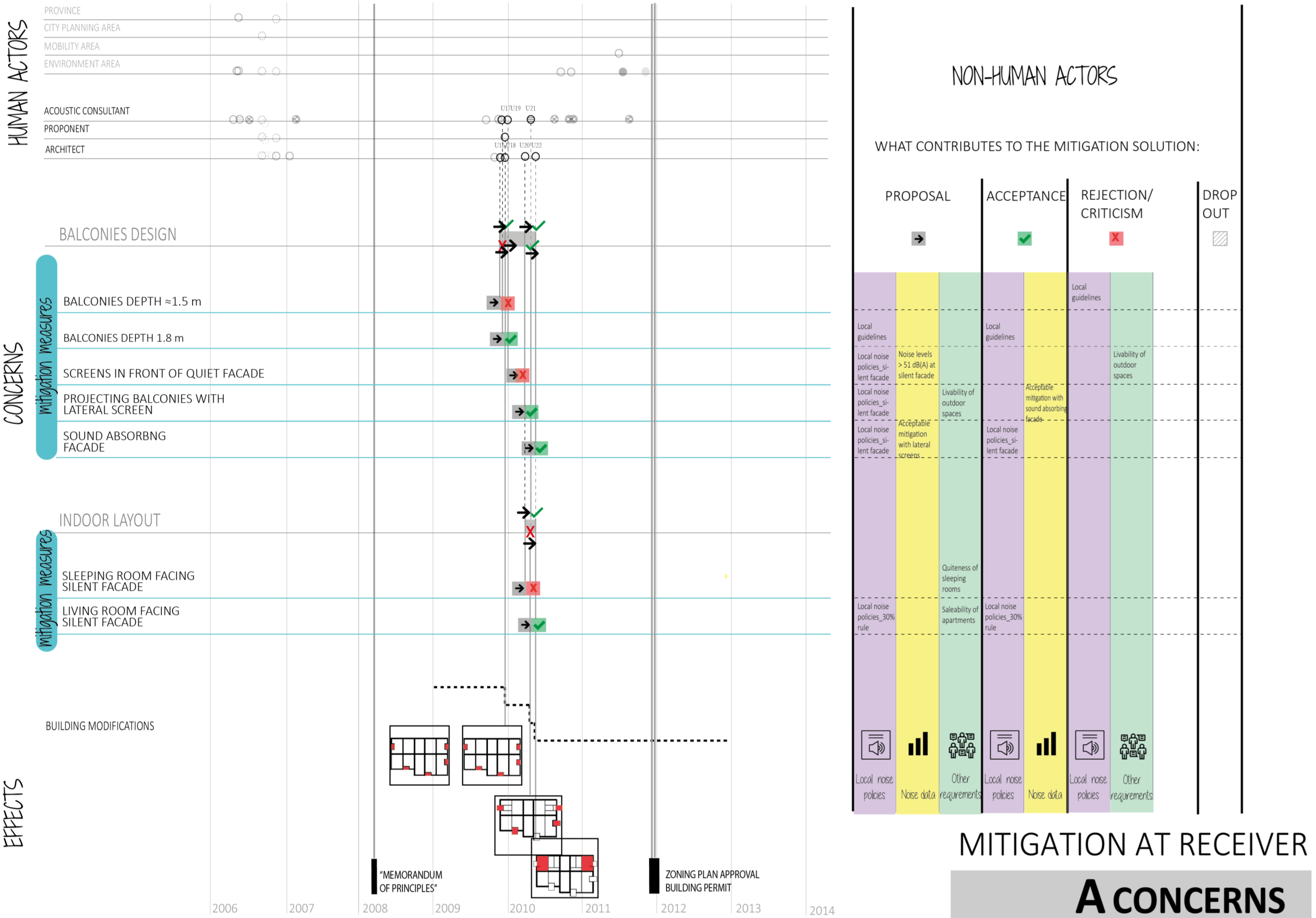


Figure 9.19 – “concern” maps exploring the *Matters of concern* related to mitigation solutions at receivers developed during the second version of the project. (a)map related to building shape and balconies position concerns; (b) map related to balconies design and indoor layout

From May 2010 onward, then, the building did not underwent further modification, and the architect was not involved in the project anymore (see the general framework map reported in Figure 9.5). Further exchanges, indeed, involved the acoustic consultants and the local Environment Area, as will be shown in the following section.

9.4 On testing methods and model data

After the design of the buildings was fixed with the drawings of 11th May 2010 [U22], the first complete acoustic report on the project was presented on 16th August 2010 [U23] (first document involved in the controversies presented in Figure 9.21).

However, the report needed to be modified shortly after, as a new noise model for the foreseen noise impact of the Sewage Treatment Plant was provided by the local Environment area on 21st October 2010 [U24], following an expansion agreement with the plant and the related environmental permit[226]

New software calculations were provided by the acoustic consultant on 28th October 2010 [U25], including new data on industry noise. The new data did not produce a considerable change in the results, hence no changes to the building design were needed.

However, a new concern emerged, related to testing methods (see Figure 9.20). On 4th November 2010, an e-mail from the local Environment area [U26] indicated that:

"What is still missing, is a detailed calculation of the silent façade [as there is] only a sketch indicating what measures need to be taken, but [...] this need to be demonstrated on a representative facade"[227]

The level of model detail in the software used for environmental noise calculation only allowed to model the building volume, without the loggias, balconies and screens used in this case to reach the requested silent façade (see Figure 9.20a).

Hence, more detailed testing methods were requested.

According to an email sent by the acoustic consultant to the proponent, a similar report, with results deriving from the same software and general indications on mitigation measures for the silent façade was judged as sufficient during the first project, in 2007[228].

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[226] Acoustic Environment report, 28th October 2010

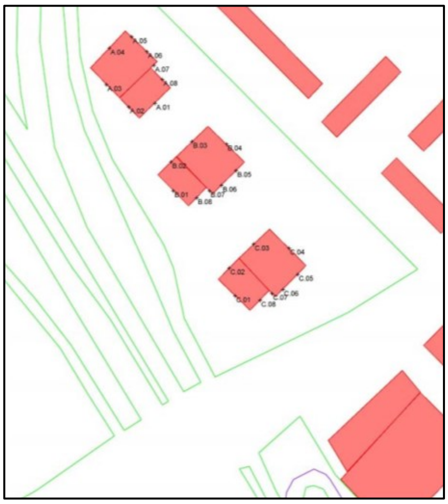
[227] In the original: *"wat ik echter nog wel mis is een berekening van de luwe zijde. Er wordt allen op een schets aangegeven welke maatregelen er moeten worden. Er wordt hechter het middels berekiningen [...] maar het moet de werking van het oplossingsprincipe op de meest maatgevende gevel"*

[228] Acoustic environment report, 7th February 2007

However, upon “extra budget” from the proponent, they provided a new report, on 12th November 2010 [U27], including analytic calculations for the silent façade (see Figure 9.20b).

The analytic calculations were performed starting from the noise levels flush at the building façade. Noise reduction due to the façade shape were then retrieved from the calculation standard GGG 97[229] for vertical section of the balcony and by the use of a vision correction formula for the Horizontal section of the balcony[230] (see Figure 9.20b)

Such report was presented to the local Environment area for the request of zoning plan approval and building permit granting.

(a) 

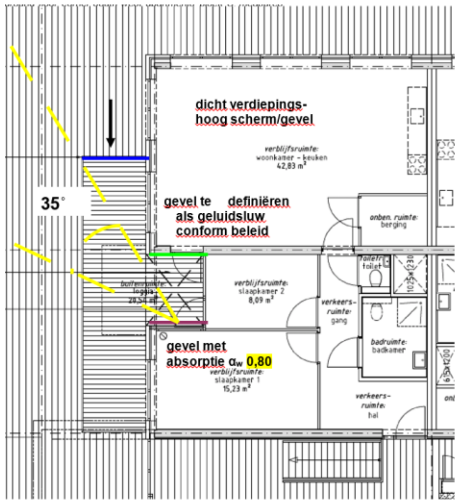
(b) 

Figure 9.20 – (a) example of the model calculations provided in the acoustic environment report on 28th October 2010; (b) drawing from the acoustic environment report of 12th November 2010, with indication of the

A response was emitted by the local Environment Area on 22nd July 2011 [U29]. The response accepted the analytical calculations as a satisfying testing method for the mitigation measures included in the project, given also the quite conservative simplifications used in the analytical calculations, hence closing the *matter of concern* on testing methods (green tick in the “testing methods” concern in Figure 9.20).

However, the same response reported that

“On 1 July 2011, the municipality of Utrecht put a new traffic model, VRU 2.0 utr 2.2, into use. In this report [12th November 2010] an acoustic comparison is made between the new traffic model and the previously used traffic model VRU 2.0 utr 2.1”[231]

[229] *Rekenmethode GGG 97 voor het berekenen van de geluidwering van gevels*, 15 May1997

[230] Acoustic Environment report, 12th November 2010

[231] In the original: *“De gemeente Utrecht heeft per 1 juli een nieuw verkeersmodel, VRU 2.0 Utr 2.2, in gebruik genomen. In deze memo is een akoestische vergelijking gemaakt tussen het nieuwe verkeersmodel, VRU 2.0 Utr 2.2, en het eerder gehanteerde verkeersmodel VRU 2.0 Utr 2.1.”*

The response included the results of an explorative evaluation done by the local office for the project area, showing that at reference points located 10 m from the axis of the roads, the increase of noise levels for the new model were of 0.1 dB for the main road (*Brailledreef)* and of 1 to 2 dB for the other roads, concluding that

"the most recent traffic information substantially alters the conclusions of the noise report

It has been demonstrated that the previous study is no longer representative of the acoustic situation. It will have to be updated on the basis of the new traffic model VRU 2.0 utr 2.2" [232]

Adding that

"If the noise investigation shows that the Noise Abatement Act and the Utrecht Noise Memorandum are not being complied with, the building plan will have to be amended accordingly or other mitigation measures will have to be taken"[233]

Traffic noise calculations are indeed performed using input data from previsions defined by the local Mobility area (e.g. number of vehicles, type of asphalt, heavy vehicles, average speed…) for the ensuing ten years[234], which are updated in relation to new transformations foreseen in the city.

New model calculations were then performed by the acoustic consultants and presented in a new report, dated 23rd August 2011 [U30]. Results of the calculations showed that an increase of maximum 1dB at the buildings facades was obtained with the new traffic data with respect to previous calculations, and hence

"The change in noise impact resulting from the calculations with the new traffic model of the municipality of Utrecht (VRU 2.0 Utr 2.2) has no relevant consequences for the plan"[235].

Figure 9.21 uses the "concern" map to visualize what presented in this section. The two *matters of concern* that emerged during the last phase of the process, after the first acoustic environment report on the definitive project was presented to the municipality, are indicated as "testing methods", i.e. the negotiation on verification modalities of required limits at silent façade, and "input data", focusing on the data

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[232] In the original: *"de meest recente verkeerskundige informatie de conclusies van het geluidsonderzoek substantiel veranderen. Aangetoond is dat het eerdere onderzoek niet langer representatief is voor de akoestische situatie. Het geluidsonderzoek zal op basis van het nieuwe verkeersmodel VRU 2.0 Utr. 2.2 geactualiseerd moeten worden."*

[233] In the original: *"Indien uit het geluidsonderzoek blijkt dat niet voldaan wordt aan de Wet geluidhinder en de Geluidnota Utrecht zal het bouwplan hierop dienen te worden aangepast of zullen verdergaande mitrigerende maatregelen moeten worden getroffen"*

[234] Interview with senior acoustic specialist of DCMR agency, 10th November 2018

[235] In the original: *"De wijziging in geluidsbelasting afkomstig uit de berekeningen met het nieuwe verkeersmodel van de gemeente Utrecht (VRU 2.0 Utr 2.2) heeft geen relevante gevolgen voor de voortgang van het plan"*

that had to be used in the noise calculation models in order for the acoustic environment report to be accepted by the local Environment Area.

For the "testing methods" *matter of concern¸* it can be seen that the two proposed solutions are firstly the use of the noise calculation software, normally used in all the evaluations (see also Section 8.1.4). The software (first of the two listed solutions) is used by the acoustic consultant in the report [U25] as it responds to the calculation methods reported in the national law (violet column in the "non-human actors" table). However, it was contested by the Environment area (red X on the software "acoustic software" line). The next report [U27] proposed then analytic calculations, which were accepted by the local Environment area [U29] (green tick on the "analytic calculations" in the map), hence closing the *matter of concern*.

For the "input data" *matter of concern*, it can be seen that three different sets of input data are used "data" list below the grey bar of the *matter of concern*). The set of data used in 2006-2007 (first line) was firstly modified when the local Environment area, on 21st October 2011 [U24], refused the previous results (red X on the map) and communicated the need to use a new industry noise model, following the expansion agreement on the Sewage Treatment Plant. New calculations were again refused in July 2011 [U26], when a new traffic model was put out by the local Mobility area, hence input data for the noise calculation model had to be changed again. The new calculation, including the data from the new industry noise model and from the new traffic model were finally accepted [U31] (green tick on the map), leading to the zoning plan approval and then to the granting of the building permit.

By looking at the "non-human actors" section, in the right part of the map, it can be seen that different categories of actors are involved also in this case in the *matters of concern*.

In particular, in the *matter of concern* related to testing methods, the noise laws (violet columns) are involved in the initial proposal of a model-based calculations, but different kind of actors are then involved in the evolution of the concern. Indeed, the particular characteristics of the balcony design, determining the position of the silent façade (beige column), together with the low level of detail that can be reached in the building model in noise calculation software (red column) determined the refusal of the model-based calculations by the municipality and the need to integrate them with analytic calculations. In order to provide a good estimation of noise levels at the silent façade in the complex design of the balcony, analytic calculations were supported by literature (fuchsia column), namely by the calculation method for façade (GGG 97) and vision correction formulas. The closure of the *matter of concern* in this case is not determined by the noise law but by the fact that the local Environment area evaluated the analytical calculation as satisfactory, given their conservative simplifications (red column in the "non human actors" table, "acceptance" part).

The examination of this *matter of concern* showed therefore that also in this case **the verification modalities of noise levels are not completely "black-boxed".** The complexity of the specific building design, indeed, led the Environment area to pose verification requirement that were beyond the standard procedure. Although the network of actors is smaller than the complex network seen for the Turin case-study in Subsection 6.5.2, therefore, also in this case **different kind of actors, linked to the specific contingent situation, were enrolled** into the network in order to make the verifications acceptable and hence close the controversy.

Such findings support again what claimed by Rydin (Rydin 2013) when underlining that verification modalities, usually emphasized as black-boxes that create incontestable evidence claim, can however be not fully closed and fixed, and therefore still open to controversies and negotiations which can greatly affect the process outcomes.

Moreover, the *matter of concern* on input data showed how the verification modalities requested by the Dutch legislation, i.e. model calculations with input data deriving from forecasts of the evolution of different sound sources in the next ten years, can also lead to issues during the process, as during the time of a project process, modification in the foreseen urban developments can result in the need to substitute input data in the calculation, potentially leading to the need of further modifications in the process.

Empirical evidences presented in Figure 9.21, therefore, sustain the claim that **more awareness is needed on verification modalities and how they may affect or being affected by other actors in the process.** The sharing of such awareness also by stakeholders that are not acoustic experts would enhance the careful integration of noise mitigation aspects in the process and an informed negotiation between stakeholders.

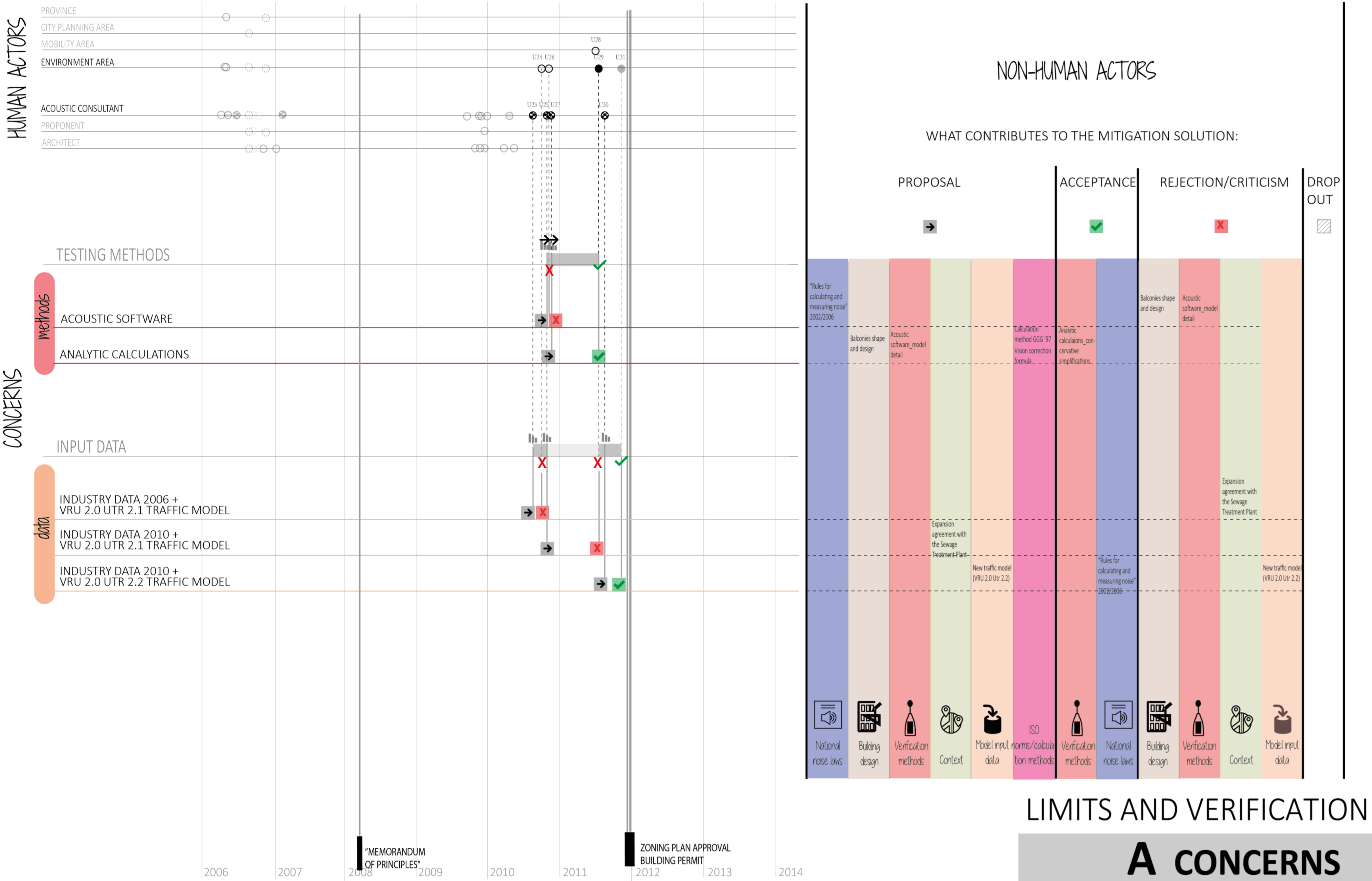

Figure 9.21 – "concern" map exploring the *matters of concern* on noise limits verification.

9.5 Following policies in the process

In this section, the second type of detail investigation map defined in Chapter 4 (see Subsection 4.3.2), i.e. "following specific actors", are used. The maps are reported in Figure 9.22 and 9.23, which follows noise mitigation policies and other policies and requirements through the process.

Figure 9.22 focuses on the presence of noise mitigation policies through the process. as resulting from the documents analysis.

By looking at the map, it can be seen **how noise mitigation laws and policies are involved in all the *matters of concern***, except for the last one, regarding input data to be inserted in the model. Therefore, in this case all the *matters of concern* on mitigation measures at the receiver involve noise mitigation legislation. In particular, national noise laws (violet rhombuses) were involved only in terms of implementing decrees establishing the preferred values to be respected at silent facades. Such decrees were involved only at the beginning of the process, as they were substituted by local policies after the 2007 modifications to the Noise Abatement Act (see Chapter 8).

On the contrary, **local noise policy (purple rhombuses) were involved in all the *matters of concerns* related to mitigation at receivers, hence to the design of the building, through the whole process.**

As seen in Section 9.3, the *matters of concern* related to mitigation at receiver were essentially debated between private practitioners, without involving the local Environment area or other local offices. This can be also seen in this map by following the lines that connect each rhombus, i.e. each time in which a policy was involved in the process, with the document that involved it. In this case, the documents connected to the policies are *memoranda,* report and communications from the acoustic consultant and documents provided by the architect and the proponent.

This was not the case in the case-study examined in Chapter 6, in which policies were involved only in responses from local offices (see Figure 6.22).

In the case-study examined in this chapter, therefore, **local policies are acting without the involved of the office that issued them.** Just as put in light in Rydin's work (Rydin 2013), in this case the Environment area **achieved therefore an agency at distance, by making policies acting on their behalf in defining the exchanges between the practitioners** and the relation between them **and the material elements of which the design solutions are composed** (e.g. the balconies and their screens, the doors, the dimension and position of rooms…).

This is due to the fact that, contrary to the case in Turin, in this **case the policies entered into the topic of building design.** Rather than being only *performance-based*, hence defining a noise limit to be reached, **the policies become *prescriptive*** (Moore and Wilson 2014), **defining minimum dimensions and standards to be respected** in the building design in order for the mitigation solutions to be acceptable (e.g. minimum dimension of silent façade, etc.).

Prescriptive policies, by setting requirements on the building layout and characteristics**, enrol designers into the definition of noise mitigation measures**. However, as put in light in Subsection 9.3.3 with respect to silent façade requirements, *prescriptive* indications **can lead to minimum requirements which are quite distant from the living quality goals** that were the original aim of the policy.[236]

[236] Interview with employees of the local Environment area involved in the process, conducted on 8th November 2018

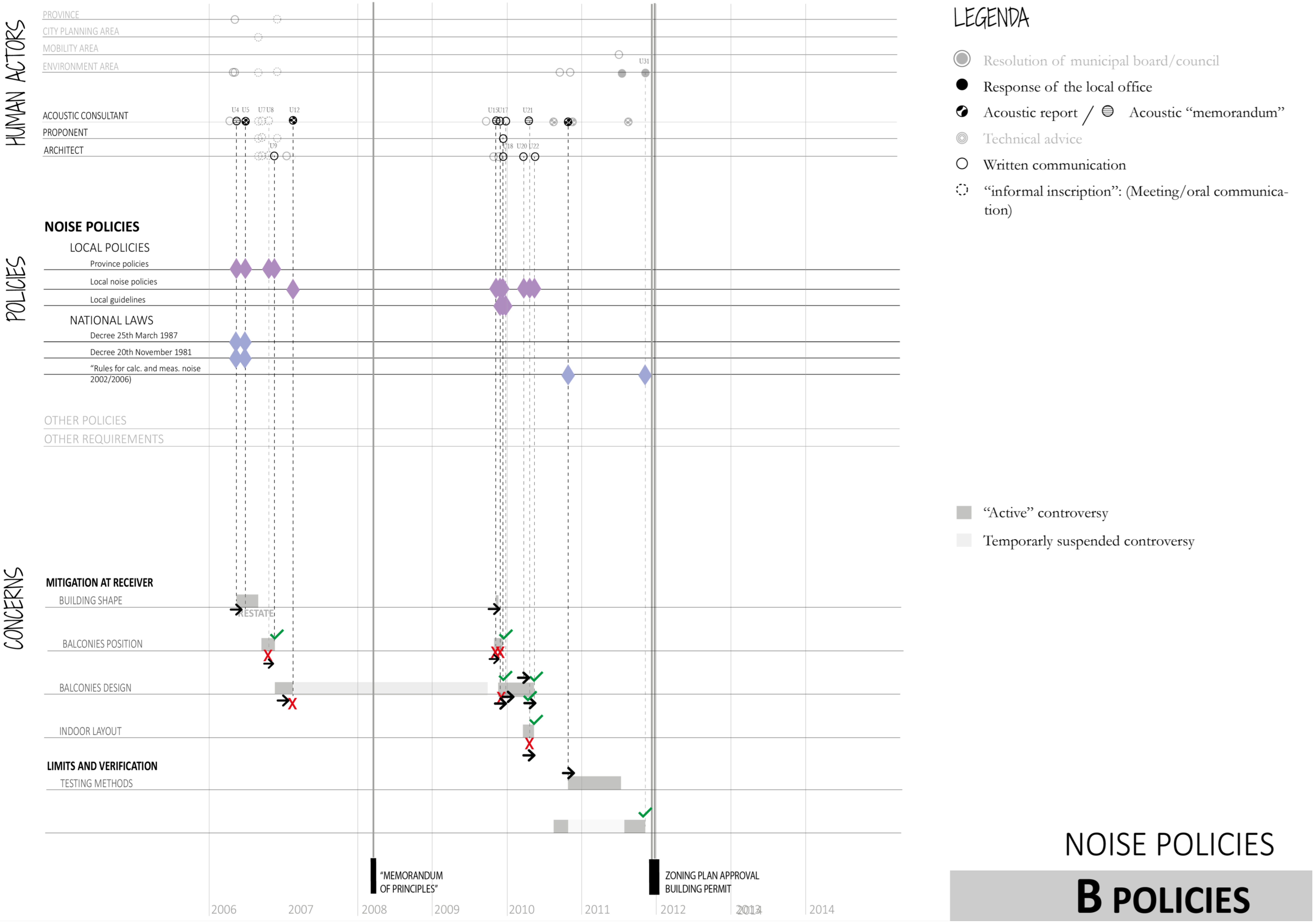

Figure 9.22 – Following noise mitigation policies through the process

Figure 9.23 puts in light the other norms and requirements which are not related to noise mitigation but were nevertheless involved in the process.

By looking at the *matters of concern* in which the policies and other requirements were involved, it can be seen that they were involved in all the concerns related to noise mitigation at receiver, hence regarding modifications on the building.

In particular, the other policies (light green rhombuses) involved were local planning policies, which were involved only in the *matter of concern* on building shape.

By looking at the points in the process in which other requirements were involved (dark green rhombuses), it can be seen that three of them were also involved in the *matter of concern* of building shape, in refusing the proposal of elongated building block.

The other requirements were put in light by the architect when proposing new solutions for balconies position and design and for the indoor layout design, except for the last one which was underlined by the acoustic consultant in relation to the indoor layout (see also Section 9.3).

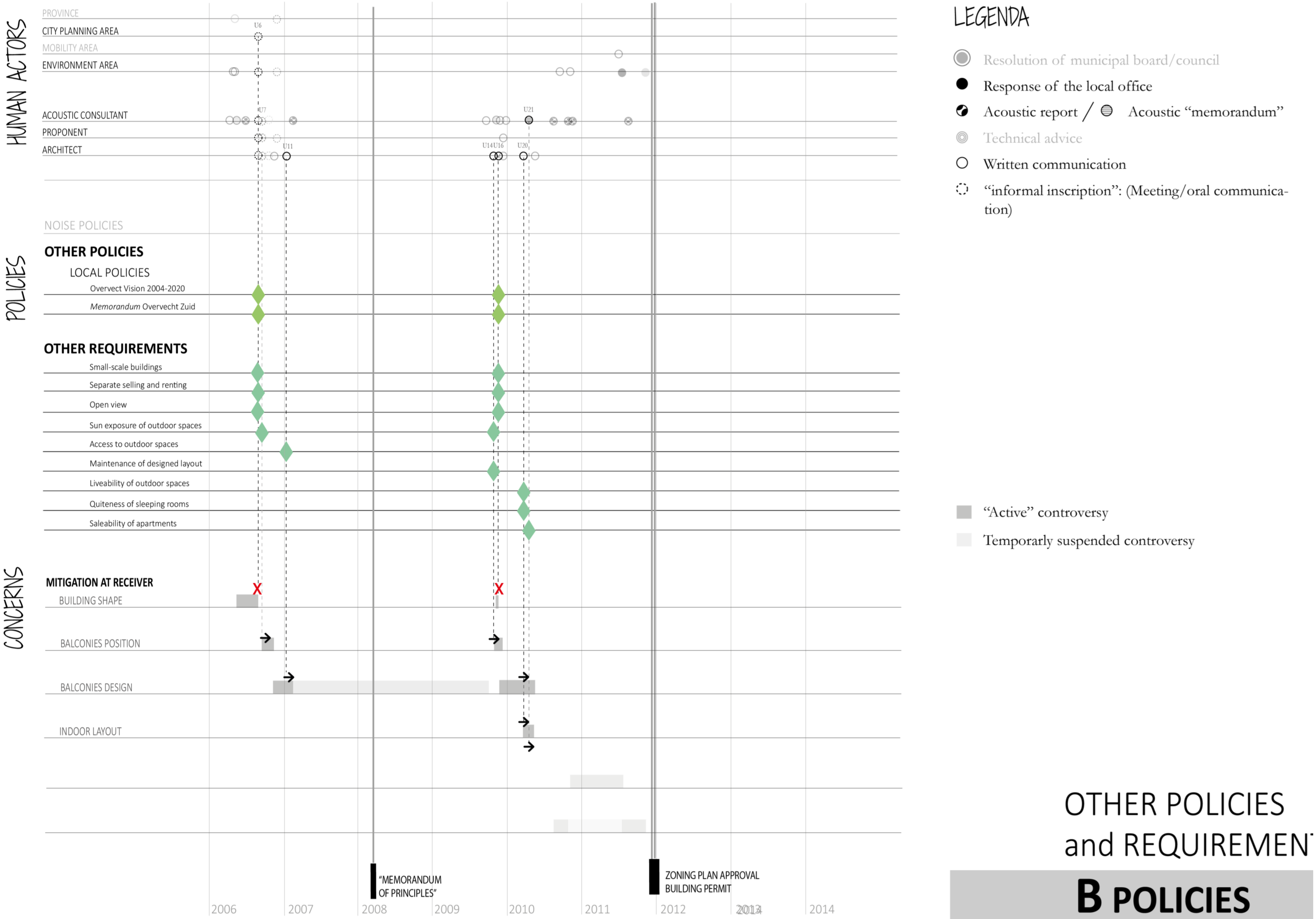

Figure 9.23 – Following other policies and requirements through the process

Figure 9.24 shows the points in the process corresponding to “unlocking” in the process (green dots in the lower part of the maps, “effects” part). In this case, only one point is present in the process, as the zoning plan approval and the granting of building permit were achieved in one coordinated procedure, as already seen in Section 9.1.

Figure 9.25 explores the network of actors involved in such decision, as done in Figure 6.25 for the case-study in Turin.

As can be seen in Figure 9.24, the network of actors involved in the decision is quite simple. National laws are present in the network as the compliance with the law in terms of both calculation methods and input data used for the model is one of the reason of acceptance of the acoustic environment report. However, also analytic calculations with good conservative estimations, and the calculation methods that informed such results had an important agency in the acceptance of the final report.

This is due to the fact that in the case of the *matter of concern* related to testing methods, a “grey area” was present in the norms with respect to specific verification methods to be adopted in case of complex design solutions.

However, no indications were found that this kind of requirements became then an established praxis that may lead to the modification of the policies.

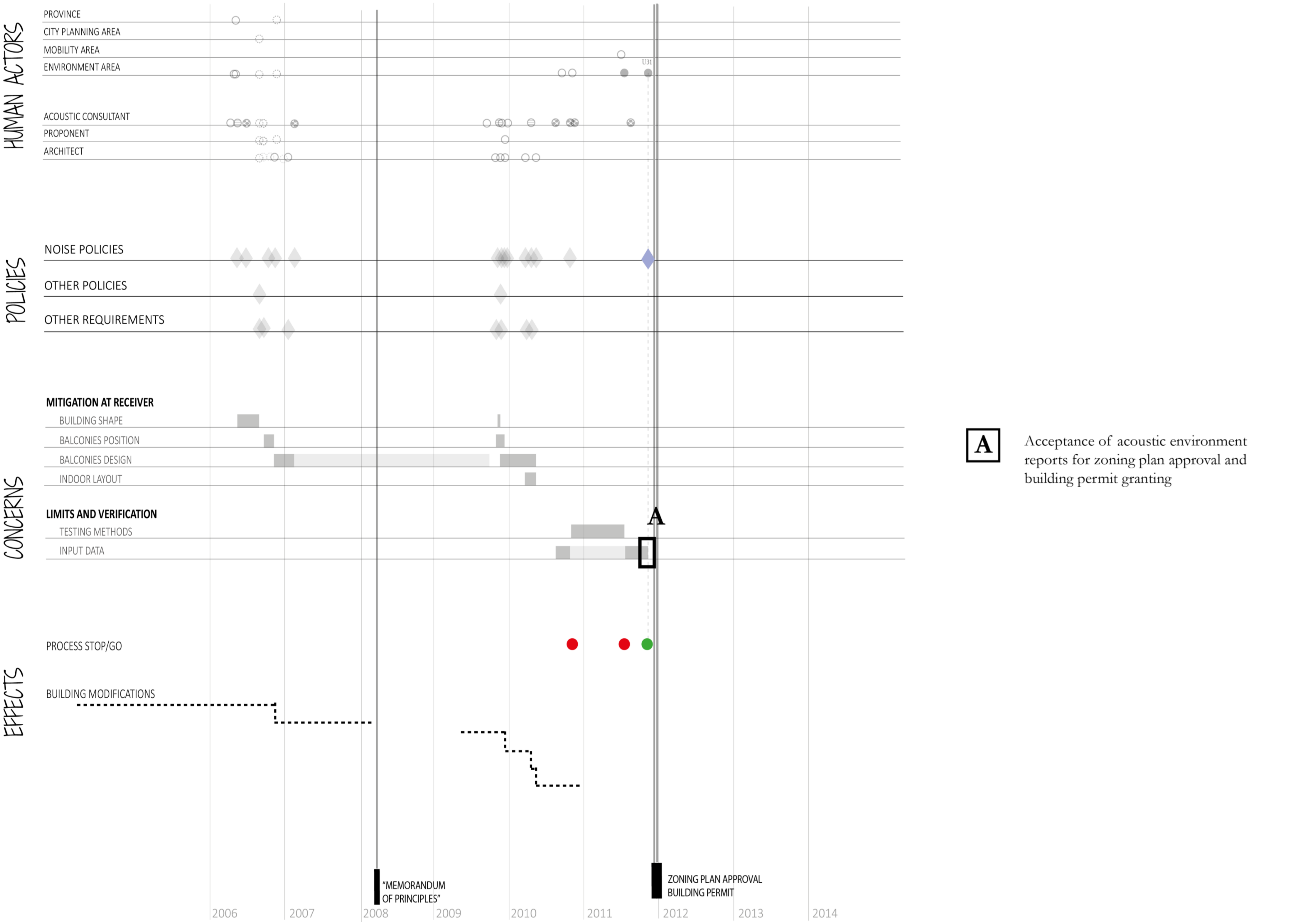

Figure 9.24 – Points in the process in which the local Environment area took decisions that allowed the closure of a bureaucratic phase of the process.

A

Acceptance of acoustic environment reports for zoning plan approval and building permit granting

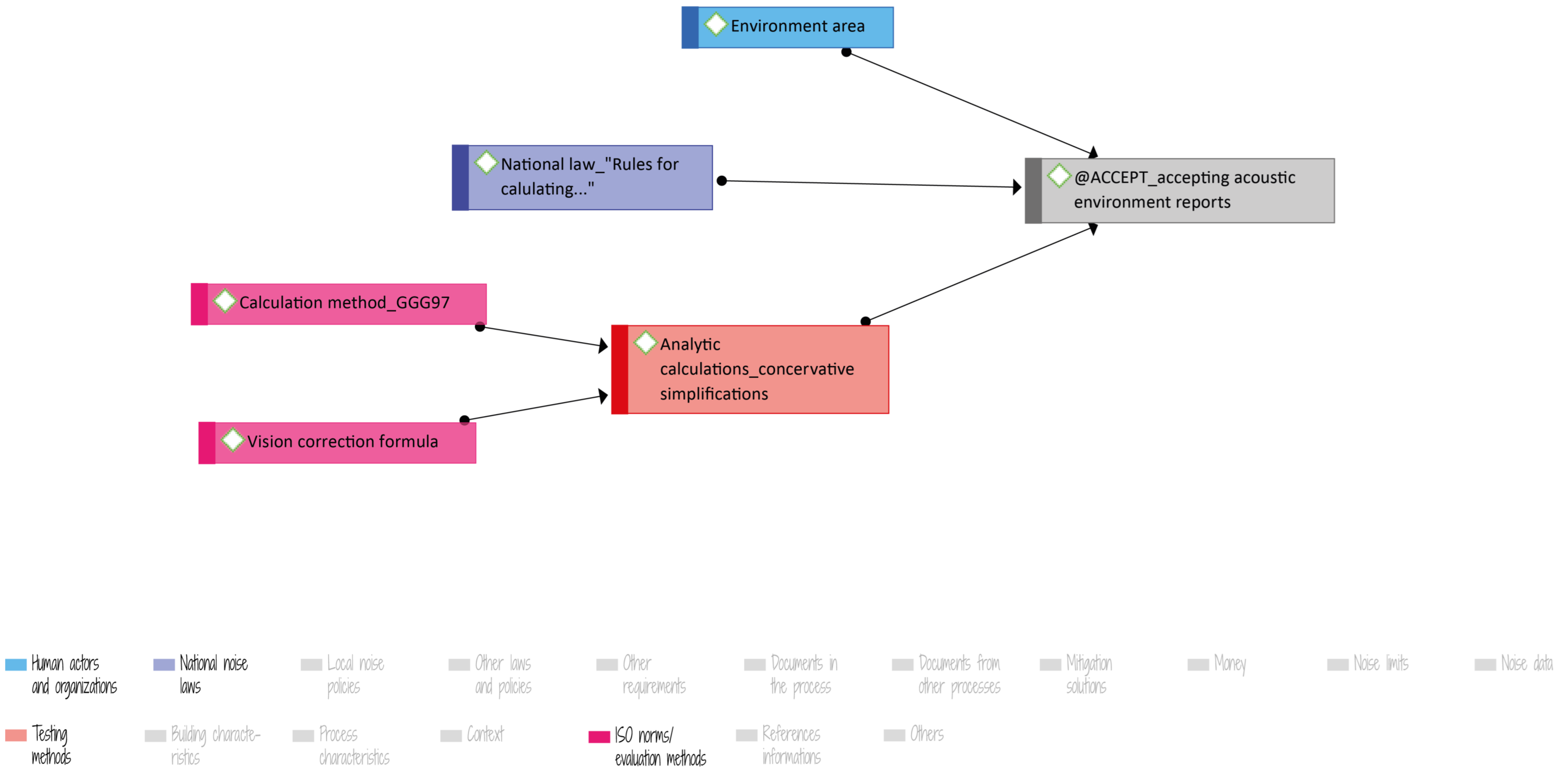

Figure 9.25 – Network of actors involved in the acceptance of the acoustic environment report

9.6 Summing up

9.6.1 Answering to research questions

<u>Concerns and involved actors</u>

- **What are the arising concerns and which are the involved actors?**

During the process of the analyzed case study emerged a first series of *matters of concern* in 2006-2007, which correspond to the first project, and a second one starting in 2009, which correspond to the second project, after the withdrawal of one of the proponents from the process, as seen in Section 9.1.

The *matters of concern* emerged during the process are related to **mitigation solutions at receiver, hence on the building itself, and to verification of the noise levels in the later part of the process**. No concerns emerged in relation to mitigation at source, as they were not envisioned, following the principle declared in the local noise policies (See Subsection 8.2.2). Consequently, no concerns emerged in relation to the realization modalities or timing of the mitigation measures, as they were all realized as part of the building itself.

As far as the involvement of human actors and organizations is concerned, the actors involved in the different *matters of concern* were limited to proponents, architect and acoustic consultant, and to the local Environment area and City planning area. In particular, the City planning area was only involved in the *matter of concern* on building shape, while the Environment area was involved in the *matters of concer* on verification methods and input data.

Therefore, **the *bureaucratic exchange* with the local Environment area only took place at the last stages of the process**, while in all the rest of the process it is shown **a *symbolic exchange* mainly between the proponent, the acoustic consultant and the architect** (Armando and Durbiano 2017). This is also undelrined by the fact that the acoustic consultant did not only produced complete reports to be presented to the local offices, but also written communications (emails) and acoustic "memoranda", i.e. short reports to provide advices to the proponent and architect on the project (see Figure 9.5).

Figure 9.26 shows the complete list of all the categories of actors identified in the process through the analysis of documents and interviews. The ones reported in grey are the ones identified in the realization of the maps for the Turin case-study, but that did not emerge in this case. Moreover, in the last row of the Figure can be seen the new categories of derived in the analysis of this case-study.

As can be seen, 15 different categories were identified, of which only five are directly related to the topic (namely national and local noise regulations, mitigation solutions, noise data, testing methods), while the others are related to other requirements and policies to be integrated and specific characteristics of the investigated case study (building, process or context).

Among the actors involved in the process, ISO standards and other calculation methods are present, indicating the fact that, as seen in the previous section, the stakeholders looked for references that could support their actions/decisions. In particular, in this case this happened in relation to verification methods, as seen in Section 9.4. In the other *matter of concern* this did not happen, due to the fact that the level of detail in prescriptions provided by local noise policies and guidelines already enrolled designers in the definition of mitigation solutions through the process, as seen in Section 9.5.

With respect to the categories of non-human actors defined during the analysis of the Turin case-study, in this case the "noise limits" category did not emerge, as no different limits with respect to the ones reported in the norms were defined during the process. Moreover, **the category "documents in the process" did not emerge, and this is consistent with the fact that the process is completely developed before any bureaucratic phase (i.e. zoning plan approval or building permit granting) is closed**. Therefore, no binding documents were produced during the process that could steer the noise mitigation issues afterwards.

Finally, the category of **"documents from other processes" also did not emerge,** indicating that in this case no previous cases were used to establish a praxis beyond norm indications. This is consistent with the **lack of "relational matrix"** between the project and norms, which will be further explored while answering to the following research questions.

Figure 9.26 – Categories of actors identified in the whole process, together with the colour assigned to them in the maps.

Translation into common goals

- **When are noise mitigation measures translated with other goals?**
- **What measures are successfully translated and what measures are not?**
- **Which kind of actors are involved in the successful or failed translation?**

As previously seen in Chapter 2, material effects on the projects happen when mitigation requirements are translated with other goal, reaching a common agreement on a project modification.

In the analysed case-study, it has been shown how such modifications happen in the early stages of the process, before the building design is fixed by the approval of the zoning plan or by any other document produced in the process. Hence, the **modifications happened in the arena of the informal, *symbolic* exchange rather than in the *bureaucratic* one** (Armando and Durbiano 2017): This is underlined by the **limited role of local offices** in the discussion of the *matter of concern*, while the exchanges are mainly between the involved practitioners.

The only *matter of concern* related to mitigation at receiver, hence involving building design, in which the noise mitigation requirements are not successfully translated is the one related to building shape. In this case, noise mitigation guidelines do not pose specific prescriptions and therefore mitigation requirements are postpone due to more stringent demands posed by other non-nose related policies (See Figure 9.8 and 9.13).

On the other hand, the other *matters of concern* ended with the integration of noise mitigation measures. In this case, the actors involved in the proposal and acceptance of different solutions are mainly linked to local policies and guidelines, and noise data resulting from the calculations, hence indicating **the role of local policies and guidelines in defining the transformations in the building design**.

In particular, in the *matter of* concern related to balconies design in the second phase of the project put in light how where the policies did not fix too strict requirements in terms of building design, a kind of negotiation happened on possible mitigation solutions. It is the case of screens, in which the architect refused the suggestion of the acoustic consultant to propose a solution that could better integrate noise mitigation with other requirements.

On the other hand, when local noise policies or guidelines defined specific rules for the building design, such as the 1.8 m depth of the silent façade in the local guidelines, or the 30% of living spaces bordering the silent façade in case of local noise guidelines, the concern was rapidly closed by the simple acceptance of the rule.

This supports what put in light by Bradbury (2016), who underlined that **true mediation of different actors' goals can only happen when there is a certain degree of flexibility in the regulations** and that when this happen, architect can gain an important role as mediators between different requirements (See subsection 2.2.1).

Policies

- **When and how do local and national policies act? Is there a "deflection to local control"?**

The map reported in Figure 9.21 showed how the national noise laws involved in the process were only the implementing decrees establishing the preferred values to be respected at silent facades before the legislation modification of 2007 and the law regulating calculation methods. Such laws were involved respectively at the beginning of the *matter of concern* on building shape and at the beginning of the *matter of concern* on verification method, at the end of the process.

On the contrary, local noise policy and guidelines were involved in all the *matters of concerns* related to mitigation at receivers, hence to the design of the building, through the whole process.

Therefore, the map reported in Figure 9.20 is the visual representation of a deflection to local control in the field of noise mitigation issues. Indeed, the local noise guidelines set not only the limits for preferred noise values, but also the requirements to be fulfilled by the building layout in order to be acceptable for the higher values exemption. Moreover, local guidelines got even more into details on defining how to interpret such requirements when defining the building design.

This is also reflected, for instance, by the fact that the ventilation requirements set by the national building decree do not even enter the process at any time, as they are already integrated into local noise policies and guidelines requirements.

- **Do the policies work as "intermediaries"?**

By looking at the map reported in Figure 9.21 it can be seen how the documents that acted in connection to noise mitigation policies and guidelines, hence involving them into the process, are *memoranda,* report and communications from the acoustic consultant and documents provided by the architect and the proponent.

This was not the case in the Turin case-study examined in Chapter 6, in which policies were involved only in responses from local offices (see Figure 6.22).

Therefore, in the case-study examined in this chapter therefore local policies acted without the involved of the office that issued them.

Just as pointed out by Rydin (2013), in this case **local noise policies and guidelines act as intermediaries**, as they contribute in enrolling the architect into the definition of noise mitigation measures, bringing architect and acoustic consultant in association with each other in defining design solutions. They have an agency in the definition of the relationship between them and the material elements of which the design solutions are composed (e.g. the balconies and their screens, the doors, the dimension and position of rooms…). **The Environment area achieved agency at a distance**, as put by Rydin (2013), by making policies acting on their behalf in enrolling practitioners in the process.

The key aspect of the policies acting as intermediaries is the level of detail with which they enter into the topic of building design, defining indications and limits for it (e.g. minimum dimension of silent façade, etc.). This is in line with what indicated by Rydin (2013).

In other words, the policies are not only *performance-based*, hence defining a noise limit to be reached, but they become *prescriptive* (Moore and Wilson 2014), defining minimum dimensions and standards to be respected in the building design in order for the mitigation solutions to be acceptable.

Prescriptive policies, by setting requirements on the building layout and characteristics, enrol designers into the definition of noise mitigation measures. However, as put in light in Subsection 9.3.3 with respect to silent façade requirements, **when a requirement is transferred from a performance to a prescriptive indications, this can lead to minimum requirements which are quite distant from the living quality goals** that were the original aim of the policy.

Are the tools used to verify compliance with policies already "black boxed"? What can be learned on their functioning?

Section 9.4 has put in light that **the verification modalities of the noise levels in this case were not completely "black-boxed"**, as a controversy emerged on the topic.

The complexity of the specific building design, indeed, led the Environment area to pose verification requirement that were beyond the standard procedure. A network of different kind of actors, although smaller than the complex network seen for the Turin case-study, was then needed to make the verifications acceptable and hence close the controversy.

Moreover, it has been pointed out how the verification modalities requested by the Dutch legislation can also lead to issues on input data to be used in the calculation model during the process.

Such findings support again what claimed by Rydin (2013) when underlining that verification modalities, usually emphasized as black-boxes that create incontestable evidence claim, can however be still open to controversies and negotiations which can affect the process outcomes.

This sustain the claim **that more awareness is needed on verification modalities and how they may affect or being affected by other actors in the process**, also by stakeholders that are not acoustic experts. This would enhance the careful integration of noise mitigation aspects in the process and an informed negotiation between stakeholders.

Is there a "relational matrix" between design and norms?

- **If so, can we witness a network of actors "acting" in the definition of the norm? Which are the actors involved?**

In the case-study examined in this chapter, **no "relational matrix" emerged during the process,** with respect to the integration of noise mitigation measures. As previously pointed out, indeed, the level of detail of the local noise policies and guidelines with respect to integration of mitigation measures within the building design acted on behalf the Environment area, who was not even involved in the *matters of concern*. The norms in this case had an important role in defining the relationship between the architect and the acoustic consultant and the material elements of which the design solutions are composed. By defining prescriptive requests and minimum standards, they traced the limits within which practitioners could move in finding mitigation solutions. Such limits were not challenged or questioned during the process itself, therefore no negotiations emerged that could need to find agreements or praxis beyond the established regulations.

The only occasion in which the local Environment area acted by setting a requirement beyond the established law was in the case of the *matter of concern* related to testing methods. In this case, a "grey area" was present in the norms with respect to specific verification methods to be adopted in case of complex design solutions.

However, no indications were found that this kind of requirements became then an established praxis that may lead to the modification of the policies.

This is supported by the fact that, as previously pointed out in this section, no documents from other projects were involved in the process, as in the case examined in Chapter 6, that could testify the transposition of a decision/requirement from one project to the other, hence leading to the establishment of a praxis that could lead, at the end, to the modification of local policies or guidelines.

Nevertheless, it must be pointed out that a "relational matrix" between projects and norms exist within the work of the local Environment area as a whole, as results from one project lead the office to question their guidelines and modify them as declared by the employees of the local Environment area in an interview in which different versions of the local guidelines were shown[237]. Reported in Subsection 8.2.2.

In this specific case, the *Bruisdreef* project was involved in a study conducted in 2017-2018 by Utrecht and Amsterdam Environment areas, together with the health authority *GGD*, of Amsterdam. The study focused on existing buildings in which limited silent facades had been obtained through screens and similar solutions, as pointed out by one of the employees of the local Environment area involved in the study[238]:

"From scientific studies we know that a real quiet façade is efficient for reducing the annoyance of people, but we don't really know if balconies with screens and things like that has an equal effect. So we wanted to study that, so we took several cases in Amsterdam and Utrecht, like Bruisdreef*, because this was a very difficult one, and they made interviews with the people living there",*

[237] Interview conducted on 8th November 2018

[238] Interview conducted on 17th October 2018

Results of the study, reported in the *Geluid* magazine under the telling title "Artificial silent sides not as good as entirely silent facades" (See Figure 9.27) may lead to further modifications in the local policies and guidelines.

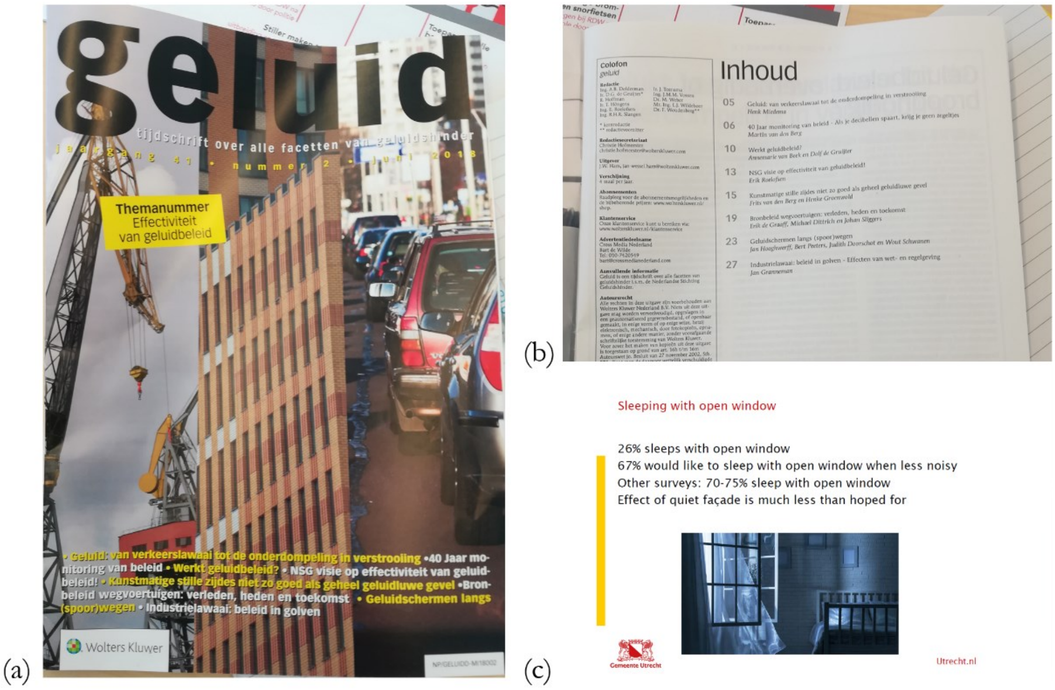

Figure 9.27 – (a) Cover of the *Geluid* magazine of June 2018 containing the results of the study; (b) table of contents of the magazine, with the study reported at page 15; (c) excerpt of the presentation of the results at the meeting of Eurocities Working Group Noise on 12th – 13th April 2018

9.6.2 Considerations on the use of the maps

As stated in the *Introduction* section and in the Overview of this chapter, the application of the maps crafted for the investigation of a case-study located in Turin on a second case-study, located in a foreign context had a double scope.

On one hand, the aim was to discover what could be learned on the application of noise mitigation solutions and related policies, with respect to environmental noise mitigation for dwellings, in a context in which law requirements are set, differently from Turin, since the Eighties.

On the other hand, the aim was to test the applicability of maps realized for the visualization of a very specific case-study (i.e. the Turin case-study, *ZUT 13.11 Moncalieri*) on a different case-study located in a different context.

While answers to the first aim have been provided in Subsection 9.6.1, by answering to the different research questions, in this section some considerations are presented on the use of the maps.

As could be seen in Subsection 9.6.1, **the maps allowed to answer to research questions defined at the end of Chapter 2**, as previously done for the Turin case-study in Chapter 6.

Hence, the three steps of analysis (*matters of concern*, actions done to move forward in the development of the concern, actors involved in each action) presented in Subsection 4.3.2, deductively derived from literature (see Chapter 2) **resulted to be quite robust to the use of the maps in different case-studies** in the context of noise-mitigation issues in architectural project processes.

The same can be said on their visual organization into maps, defined in Section 4.3.

Some minor adjustments were needed in the categories of documents and of non-human actors involved in the process, inductively-derived from the analysis, as could be expected from projects located in very different contexts.

In particular, one different kind of document (*memoranda* sent to the proponents by the acoustic consultants) was added to the categories, while technical advices from third parties and resolutions from the municipal board or council were not featured in the process, consistently with the human actors and organizations involved in the process (see Legend of Figure 9.5, showing the general framework map of the process).

One new category of non-human actor also emerged from the analysis, namely the input data for noise model calculations, consistently with the fact that in Dutch legislations calculations are done on prevision data for the following 10 years, provided by the different offices in charge.

On the other hand, no documents produced during the process itself, consistently with a *symbolic* exchange that took place before any bureaucratic phase produced any document that could affect noise mitigation measures. Moreover, no documents produced during other processes, as well as noise limits established beyond established legislation emerged in the process, underlining the absence of a "relational matrix" between project and norms, at list within the specific case-study.

As a whole, it could therefore be said that the inductive categories of documents and non-human actors defined during the analysis of the Turin case-study were generally useful also for the Utrecht case-study and that the method of inductively-derived categories resulted therefore flexible enough to accommodate the differences of the Utrecht case-study.

Moreover, although in this case a strict comparison between the two cases was out of the scope of the work, given the very different context in which they are located, the differences in documents and non-human actors categories resulted to be useful in providing a first overview on some of the characteristics of the process.

Therefore**, similar maps could be useful in a more rigorous comparison between case-studies, when performed on a more extensive pool of cases with similar premises.**

The "concerns" and "policies" maps also resulted to be robust enough to the use on a different case-study, located in a different context.

Some issues of **scale of representation** emerged, as the will to keep the same scale of representation for all the maps presented in the thesis leaded to the fact that for the Utrecht case-study, in which *matters of concern* have a much shorter duration in time, the scale of representation might not be optimal.

In the same way, when using this visualization method for other case-studies, finding a common scale of representation might pose some issues.

Similar issues **should be successfully overcome with the use of digital interactive visualizations**.

Finally, since the investigation of the Utrecht case-study put in light some points in which mitigation measures were integrated into the process not as a result of the *translation* with other requirements, but as the result of a prescription provide by the local noise policies or guidelines, maybe a new layer of representation, or a new action symbol, could be defined to **render immediately visible when *prescriptive* policies impede a *translation* with other non-noise related requirements and therefore the mitigation solution is inserted into the project maybe at the expenses of other requirements**, as put in light by Bradbury (2016). This would help to put in light **were the lack of flexibility in the policies might limit the designers in finding solutions** for a successful translation of different requirements (Bradbury 2016), as also put in light by the employees of the local Environment area (see Subsection 8.2.2), hence providing important information for policies revision and enhancement.

Conclusions

The present work has assessed the issue of noise mitigation in urban transformations. It has pointed out how environmental noise is gaining increasing attention from both the scientific community and public opinion, as its effect on health and well-being are being demonstrated. In particular, in an urban context the pressure of densification often conflicts with the need to protect inhabitants from various noise sources, and this may cause complex issues in urban transformation processes.

The role of architects and planners in finding solutions to such conflict has been increasingly acknowledged, and a considerable number of studies on possible solutions has been developed. Such works are usually focused on the evaluation of many possible design and technical solutions, all tested within the same simplified context (usually virtual or scale models), in order to compare the reduction of noise levels that can be achieved within the same boundary conditions. Knowledge is developed therefore through large quantities of data derived from repeated experiments in a controlled environment, aiming to maximise performances from the acoustic point of view, in the typical paradigm of experimental science and technology.

However, up to now, the integration of technical solutions and policies for noise mitigation within the complexity of real case studies has been underresearched. **Since the ultimate aim is to apply solutions within the messy complexity of the real world, this study claimed the need to approach the problem from a new perspective**, and hence to develop higher awareness on how technical solutions and noise mitigation policies are affected by the contingent context in which they are applied (Chapter 1).

The thesis tries to develop this new approach by shifting from the above-mentioned paradigm of experimental sciences to the paradigm of social sciences, which engage with **close observation of real case studies** in order to reconstruct the thick mesh of stakeholders, laws and requirements which influenced the process.

The basis for the workwas derived from a literature examination of previous studies that assessed architecture and codes in architecture from a perspective based on **Science and Technology Studies (STS) and Actor-Network Theory (ANT) theoretical background**. The literature allowed the derivation of a series of research question to guide the investigation of real case studies (Chapter 2).

Moreover, starting from the request for **a new visual vocabulary** brought to light by STS and in particular by ANT scholars, in order to represent buildings not only as objects but also as complex processes, this work engaged with the development of visualization that could help narrate the investigated processes, by addressing the research questions. Indications for the crafting of such visualizations were derived from the analysis of previous studies that have tried to answer to this question through new visual devices. Indications for possible ways **to evaluate the results** of the visualization effort were also derived from previous literature, based on the concept of ***critical proximity*** theorized by Bruno Latour. (Chapter 3).

The visualizations were developed during the investigation of a specific case study, using a Noticing, Collecting and Thinking (NCT) approach, in which data gathering, analysis and visualization mutually informed each other. **A 3-step analysis was defined from the literature background and conducted through the support of CAQDAS** (computer-aided qualitative data analysis software). Software-derived visualizations were then **expanded through hand-drawn visualizations,** organized in different levels that were progressively refined as the analysis of the case-study progressed (Chapter 4).

The selected case-study for the investigation was **a transformation area in Turin,** in which complex issues derived from noise mitigation requirements. The case-study was analysed and narrated through the above-mentioned visualizations. The findings were summarized by answering to the previously defined research questions (Chapter 6).

The visualizations produced during the analysis of the Turin case-study were then **put under test through a focus group with the involved stakeholders**, following the *critical proximity* approach. (Chapter 7).

Moreover, **the application of the same visualization methods has been tested on a foreign case study**, with the aim on one hand to discover what could be learned on the topic in a context in which law requirements have been set, differently from those in Turin, since the Eighties. On the other hand, the aim was to test the applicability of maps realized for the visualization of a very specific case-study on a different case-study located in a different context (Chapter 9).

The **following sections review the findings of the work**.

The first section reflects on **what could be learned on the specific issue** of environmental noise mitigation in urban transformation **through the application of the Science and Technology Studies perspective**, by summarizing the outcomes of Chapter 6 and 9, presenting the investigations of the case-studies in Turin and in Utrecht, respectively.

The second reports **an evaluation of the visualization crafted in the study**, reporting a summary of the results of the evaluation through a focus group, presented in Chapter 7, and of the use of the maps for a foreign case-study, presented in Chapter 9.

The third section reports **an evaluation of the methodology of inquiry used in this study**, presenting its strength and drawbacks.

Finally, **indications for future work~~s~~ and research directions** are derived from the reviews of the findings of the work, as a way to reflect on the potential future scenarios that this work may lead to, and therefore, ultimately, on its possible value within the research panorama.

What could be learned on the specific issue of noise mitigation from close observations?

Through the investigation of two real case-studies through the perspective provided by Science and Technology Studies and their visualization through the methodology crafted in the present work, it was possible to answer ~~to~~ the research questions determined at the beginning of the work and find some empirical evidence of the findings in the literaturereviewed in order to define such research questions.

More detailed examination of such findings is reported in the closing sections of Chapter 6 and Chapter 9, however here the most important aspects of the application of this methodology are summarized.

The results highlighted that a project process can indeed be seen as a series of *matters of concern* that evolve in time and involve variable network of human and non-human actors, even when the process is observed only from a very specific point of view (as in this case was done with noise mitigation issues).

The visualization made it possible to put in relation on the timeline the different documents produced in the discussion of each controversy, the human actors and organizations that produced such documents and the bureaucratic phases of the project, and the material effects on the project.

In particular, in this case it was shown how the raising of the major number of controversies after the closing of the first bureaucratic phases in the case of Turin determined the **involvement of a higher number of local authorities,** including resolutions from the municipal board, **while a relatively small modification of the project, and in particular of the building itself, derived from such complex exchanges.**

On the other hand, in the Utrecht case-study the development of all the *matters of concern* before the closing of the bureaucratic phases of the project determined **the enrolment of a limited number of human actors and organizations in the concerns and on the other side a series of important modifications in the building design that allowed the integration of noise mitigation requirement**s. This supports the suggestion by Armando and Durbiano (Armando and Durbiano 2017) when advocating for a more *comprehensive strategy* which can include all the possible requirements and issues at the initial stages of the process, by **complicating the process more at the beginning, when the openness of the project to modifications allows the *translation of* different requirements into designs which are approved by all the stakeholders, hence avoiding major**

concerns and long negotiations in the following phases, in which the project is more difficult to modify, as bureaucratic boundaries have already been established.

As for the *matter of concern* emerged during the process and the involved actors, it has been shown how in the Turin case study the *matter of concern* were related to: mitigation solutions at source (i.e. on the road), mitigation solutions at the receiver (i.e. at the building), realization modalities of such solutions, limits to be set and related verification modalities of noise levels. In particular, the concerns on realization modalities are related to mitigation solutions at source, as they depend from many different human and non-human actors apart from the proponent, as they are closely connected to the realization of infrastructures and underground utilities. Such controversies were strongly linked to requests of realization timing that, while trying to split the burden of mitigation solutions within the different allotments of the project, did not fit the timing of the building site (especially for noise reducing asphalt, see Chapter 6).

On the other hand, the *matters of concern* related to noise mitigation at receiver determined very small changes in the project, as most of them could not be realized due to the late emerging of the issue, when the design of the building had already been fixed by the closing of previous bureaucratic phases. This is underlined by the fact that among the actors involved in the process previous documents produced in the process, as well as other norms and requirements, have a certain role.

In the Utrecht case study, the *matters of concern* emerged during the process are related to mitigation solutions at receiver, hence on the building itself, and to verification of the noise levels in the later part of the process.

As far as the involvement of human actors and organizations is concerned, the actors involved in the different *matters of concern* were limited to proponents, architect and acoustic consultant, and to the local Environment area and City planning area, for a limited extent (see Chapter 9).

In this case, concerns on mitigation solutions ended in most cases with the integration of such solutions within the building design, hence posing a modification to the building.

Such findings underline how although the realization of mitigation solutions in different allotments, as proposed in this case, might be a valuable solution to help developers acting in different steps, such realization should be driven by a comprehensive project, to be designed before the request of the different building permits, in order to properly schedule the solutions so that they do not conflict with other issues. Moreover, noise mitigation at receiver, involving the design of the building, could be a good solution as they may not require extra time and agreement with other parties for their realization, since are integrated in the building design and realization. Of course, this requires to tackle the issue at the very first design stages. Although such solutions are likely to cause *matters of concern* in the initial phases of the project, when the building design needs to integrate them with other requirements, such solutions are indeed less-likely to cause *matters of concern* related to timing and modalities of their implementation, hence involving different local offices, as they are realized as part of the building itself.

By moving the issue of mitigation solutions to the initial phases of the project process and including mitigation solutions at the receiver, **a crucial role of mediator between noise mitigation issues and other requirements could be played by the architect, reinforcing his role as part of the design process** (Bradbury 2016).

The outcomes of the analysis of the two different case studies and their representation through the crafted maps also made it possible to relate national and local legislation on noise mitigation to the exchanges between stakeholders and the related *matter of concern* in which they were involved.

This made it possible to shed light on whether policies are only referred to by local Environment area or if they are also involved in exchanges between other stakeholders, working as intermediaries between them. It also allowed verification of the extent to which the policies acted in the definition of mitigation solutions and whether the different steps in the process were determined only by normative requirements or whether new praxis needed to be established due to the pressure of the specific contingent situation.

In particular, the research showed that in the Turin case-study, in which policies set requirements in terms of noise limits to be reached at all the facades of the building, **without posing indications or prescriptions related to mitigation solution design, the policies did not have an agency in the *matters of concern* related to the definition of mitigation solutions**. Hence, they did not act as an intermediary between different stakeholders when defining possible mitigation solutions. The lack of normative requests on mitigation solutions at receiver, together with the late tackling of the issue (after the design had already been fixed by the approval of the executive planning instrument) **did not enrol the architect in the noise mitigation issue**. This is reflected by the almost complete absence of this stakeholder in the controversies.

Moreover, **the lack of prescriptive indication on mitigation solutions**, in a newly-established policy, led to a “grey area” in which the local Environment area and the other involved stakeholders had to define praxis of action that go beyond legislation and were then transposed into other projects, hence acting as “designer” of norms, with the help of information from literature and from previous case-studies. This brought to light **a “relational matrix”, as stated by Imrie, (Imrie 2007) between projects and norms, in which not only the project changes because of normative requirements, but also the norms change because of a contingent situation that needs to establish a new *modus operandi***.

The exploration of the circumstances in which such practices were established shed light on the varied network of actors that are involved in their definition, hence supporting the claim of Moore and Wilson (Moore and Wilson 2014), who highlighted how codes and norms are not the result of a purely performance problem, but are the result of a complex network of (human and non-human) actors, hence can be seen themselves as evolving sociotechnical artefacts.

The categories of actors involved in such decisions encompasses instances to which the project had to respond, either because of specific characteristics of the area or of the process, or documents which have been previously produced in the process and that influenced further decisions, or because of other laws and requirements to which this type of transformation has to answer. Moreover, **the use of data from previous experience and literature also plays an important role in informing the decisions.**

This highlights on one hand the **need for ~~an~~ integrated work and enhanced communication among the different local offices**, so that different requirements do not lead to documents which bind aspects of the project that might be contradictory. On the other hand, there is the **need to make more data available to support decisions and dissemination of practices.** Hence, experiences from environment agencies, practitioners and local offices should be disseminated, and more academic research might be devoted to provide data and support local offices in similar decisions.

This, in turn, supports the need to **enhance research efforts into the investigation and dissemination of real processes** and the creation of a "body of knowledge", as highlighted in Section 2.3.

On the other hand, in the Utrecht case study the high level of detail with which local noise policies and guidelines on the topic of building design, defining indications and limits for it (e.g. minimum dimension of silent façade, etc.) led them to have an important role in the *matters of concern* related to mitigation solutions at receiver, hence to building design.

The level of detail did not leave "grey areas" on this topic, hence no relational-matrix between norms and projects was witnessed.

By exploring the involvement of policies through the whole process, it was shown how such policies act in the exchange between architect and acoustic consultant, in which the local Environment area is not even involved.

Therefore, the policies allowed the Environment area to reach agency at a distance, or in other words to steer integration of noise mitigation requirements without being directly involved in the negotiations. **The policies acted indeed as intermediary between private practitioners, shaping the relationship between them and the material elements of which the design solutions are composed** (e.g. the balconies and their screens, the doors, the dimension and position of rooms…). This is in line with what has been presented by Rydin (Rydin 2013).

In other words, **the policies are not only *performance-based*, hence defining a noise limit to be reached, but they become *prescriptive*** (Moore and Wilson 2014), defining minimum dimensions and standards to be respected in the building design in order for the mitigation solutions to be acceptable.

However, the study has highlighted how when a requirement is transferred from a performance to a prescriptive indication~~s~~, this can lead to minimum requirements which are quite distant from the living quality goals that were the original aim of the policy.

Moreover, the definition of **too specific prescriptive requirements can lead to the impossibility of reaching a real translation with other requirements**. In such cases the integration of noise mitigation requirements may happen at the expenses of other requirements, as highlighted by Bradbury (Bradbury 2016), who underlined that true mediation of different actors' goals can only happen when there is a certain degree of flexibility in the regulations (See subsection 2.2.1). This emerged in the Utrecht case-study, in which the noise mitigation requirements are not successfully translated is the case of the *matter of concern* related to building shape. In this case, noise mitigation guidelines do not pose specific prescriptions and therefore mitigation requirements are postpone due to more stringent demands posed by other non-nose related policies.

In some points of the examined process, however, such as in the case of noise screen design, **the absence of prescriptive indication allowed the architect to define a new solution which could successfully integrate the noise protection requirement with the need for more spacious and liveable outdoor areas**. As claimed by Bradbury (Bradbury 2016), a certain degree of uncertainty and flexibility in regulations in a specific project context allows the architect to act as mediator between different requirements and stakeholder, hence reinforcing the importance of the role within the process. As also pointed out by the interviewees in the Utrecht Environment area (see Subsection 8.2.2), prescriptive regulations that do not allow for flexibility may lead to "unpredictable design processes" where goals of regulations are transported into the project without being correctly integrated with other requirements (Bradbury 2016).

Findings from this study therefore suggest that a good balance between providing the needed flexibility and support interactions between practitioners in the definition of mitigation design solutions may be the **definition guidelines that provide suggestions of possible design solutions that help enrol designers into the process, without becoming prescriptive indications**. This would help designers to gain the central role in tackling the "contemporary city dilemma" of environmental noise pollution.

Finally, empirical evidence from both the investigated case-studies shows how verification modalities of the noise levels in this case were not "black-boxed", as a controversy emerged on the topic. Such findings support ~~what claimed by~~ Rydin's claim (Rydin 2013) when underlining that verification modalities, emphasized as black-boxes that create incontestable evidence claim, are however often black boxes that are not fully closed, and therefore still open to controversies and negotiations which can greatly affect the process outcomes.

It therefore supports Rydin's claim **that more awareness is needed on verification modalities and how they may affect or beaffected by other actors** and design solutions, also by stakeholders that are not acoustic experts. This would **enhance the careful integration of noise mitigation aspects in the process and an informed negotiation between stakeholders.**

As a concluding remark, it can be pointed out that in general, the findings reported in this section underlined **the need to enhance the research effort on investigation of noise mitigation issues in real case studies and their**

dissemination. This would help local offices to take informed decisions when designing norms and establishing praxis for their implementation.

Moreover, the investigation of real case studies would enhance the awareness on codes and testing methods within complex processes. More awareness on how codes tackling the issue in different ways relate ~~with~~ to the other actors in the process and influence the project outcomes, as well as on how verification methods can influence the process and, being influenced by it, would **enhance ~~they~~ careful design and an informed negotiation between stakeholders.**

As underlined by Bradbury (Bradbury 2016), this work is just a small step in this direction. However, **"much more comparative work is needed to understand the many different contexts"** in which noise mitigation issues affect urban transformations.

What could be learned regarding the media used to map the processes?

In this work, visual representations have been produced during the investigation of the case-study of an architectural project located in the city of Turin, in order not to describe the physical object, but rather the process of its design and approval, with a specific focus on environmental noise mitigation issues.

The crafting of these kinds of visualization tools derives from the view of architecture projects promoted by Actor-Network Theory and Science and Technology Studies scholars, that advocate for new visual vocabularies to allow the understanding of buildings as results of complex processes evolving in time and involving different actors. The research for possible ways to structure such visualization tools was started from the *mapping controversies* approach, an ANT-based teaching philosophy, deriving from the method some operative indications for working on data collection and representation. Moreover, ANT- and STS-based studies that have worked on various visualization schemes, focused either on network-based visualization or on the representation of the process evolution in time, have been examined in order to derive indications for the crafting of visualizations that could be useful to answer to the specific questions of the present research (see Chapter 3).

In particular, on the basis of previous literature and of the research questions defined in Chapter 2, data collection and representation have been developed simultaneously in order to inform each other and the visualizations have been developed with the aim of making the complex process legible and understandable, without oversimplifying it.

The visualizations developed in this research have been organized in order to visualize the development of the process in time, **organizing information on different levels**, namely:

- The stakeholders involved in the process, through the documents they produced;
- The controversies *(=matters of concern)* that emerged during the process and their development in time:
- The actions taken to find a solution for the *matter of concern*
- Possible solutions that were evaluated for reaching the closure of each controversy;
- The categories of non-human actors that influenced each action;
- Within those actors, in particular the role of noise-mitigation policies;
- The material effects on the project of all the examined controversies (see Chapter 4).

The crafted visualizations have then been tested by presenting them in a focus group with the representative of the local offices involved in the Turin case-study followed in this research, following the principles of ***critical proximity*** defined by Bruno Latour.

A qualitative content analysis was conducted on the material collected during the focus group, looking for the parts of the maps which were discussed and how the legibility, accuracy and agency of the maps in engaging stakeholders and enhancing new perspectives on the process emerged in the discussion, in relation to the different parts of the maps (see Chapter 7).

The results showed that **the map had in general positive feedback~~s~~ with respect to legibility. The maps also showed a certain agency in enhancing a new perspective on the process and interactions and clarifications between stakeholders**.

In particular, the following indications could be derived for further use and implementation of the maps:

The visualization of **the "cloud of documents" issued during the process was particularly appreciated**, as it made it possible to see how the production of documents moved through successive "waves" under the urgencies of acceptance and granting of specific documents.

Lines connecting the various documents were requested as additional visual elements, in order to picture the path of the discussion and use the slope of such lines as a visual metric for the time-span which occurred between one report and the related response.

The **visualization of time-span of the different concerns with respect to the phases of the process** (from masterplan variation approval to granting of the building permit) **was reported to enhance awareness** on how a certain topic of discussion was brought up, and was indicated as useful for possible future discussions between local offices.

The visualization of material effects in relation to the different matters of concern was also appreciated and indicated as useful for possible future discussions between local offices. It was judged as particularly effective in the maps where it is possible to see the direct connection between the choice of each mitigation solution~~s~~ and its material effects on the project ("concern" maps, see Chapter 4).

In the same maps, **the visualization of the list of all the proposed mitigation solutions, together with the indication on the timeline of when they were proposed, accepted or discarded, had an agency in enhancing exchanges between stakeholders and new awareness on the topic**, hence it should be kept in future development of similar maps.

A need ~~of~~ for more interactive maps was brought up by the participants, as they expressed the need to see the information more gradually and not all together in a static map, although divided in different zooms.

Moreover, the maps were also **put under test ~~also~~ by using them in the investigation and visualization of a different case-study** located in a foreign context, namely in the city of Utrecht.

The maps made it possible to respond to the research questions defined at the end of Chapter 2 also in the case of the Utrecht case-study. Hence, **the three steps of analysis (*matters of concern*, actions done to move forward in the development of the concern, actors involved in each action)** presented in Subsection 4.3.2, deductively derived from literature (see Chapter 2) **resulted to be quite robust ~~to~~ in the use of the maps in different case-studies** in the context of noise-mitigation issues in architectural project processes. **The same can be said on their visual organization into maps**, defined in Section 4.3.

Some minor adjustments were needed in the categories of documents and of non-human actors involved in the process, inductively-derived from the analysis, as could be expected from projects located in very different contexts. As a whole, the inductive categories of documents and non-human actors defined during the analysis of the Turin case-study were generally useful also for the Utrecht case-study and ~~that~~ the method of inductively-derived categories therefore proved flexible enough to accommodate the differences of the Utrecht case-study.

The "concerns" and "policies" maps also proved to be robust enough to ~~the~~ use on a different case-study, located in a different context.

Some issues of scale of representation emerged, as *matters of concern* have a much shorter duration in time in the second case study. In the same way, when using this visualization method for other case-studies, finding a common scale of representation might pose some issues.

Similar issues should be successfully overcome with the use of digital interactive visualizations.

Finally, the investigation of the Utrecht case-study highlighted the possibility for future visualization to be implemented to render immediately visible when *prescriptive* policies impede a *translation* with other non-noise related requirements. Therefore the mitigation solution may be inserted into the project at the expense~~s~~ of other requirements, as shown by Bradbury (Bradbury 2016). This would help **to show where the lack of flexibility in the policies might limit the designers in finding solutions for a successful integration of different requirements** (Bradbury 2016), as also highlighted by the employees of the local

Environment area (see Subsection 8.2.2), hence providing important information for the revision and enhancement of policies .

As a general conclusion, the visualizations crafted in this study showed good results in enhancing a new perspective on the investigated project, improving awareness of the process within involved stakeholders and interactions and clarifications between them. Therefore, **the results of this study support the advocacy of new visual vocabularies promoted by ANT scholars, as it demonstrates their efficacy on a real case study.**

Moreover, the design of the maps presented in this project, given the results pointed out in this section, could be **considered as a good starting point for new representations of processes in similar studies.**

What could be learned concerning the research methodology? Strengths and drawbacks

In this research, the aim was to study the process of real, "ordinary" case studies, in order to **share grey knowledge which is produced in local offices and practitioners' studios.** By gathering and sharing a "body of knowledge" on how policies and technical solutions interact with the complexity of real projects, indeed, more informed choices could be allowed on similar cases in the future.

Results from the analysed case-studies supported the need to enhance research efforts in this direction, by demonstrating on one hand the need for enhanced integration and communication between different local offices, and on the other hand the need to make more data available in order to support decisions and dissemination of practices. This underlines the need for academic research devoted to enhance such dissemination and communication between non-academic subjects, **also through the use of new visualization methodologies**.

The strength of this work, we claim, is to **try to take a step towards this direction, by also putting under test the obtained results,** in terms of visualization and dissemination of the investigated case-studies. The results obtained through this testing could therefore be of some use for future, much-needed studies in this direction.

On the other hand, **the investigation of unpublished studies poses some undeniable issues.**

Firstly, it is of course impossible to build an initial literature-based overview of the pool of possible case-studies from where to pick up the selected ones. The discovery of possible case studies can only happen by entering local offices and practitioners' studios, following their guide through the case they select from their personal experience, trusting them in this selection.

Although this is perfectly in line with the "following of the actors" and "listening to actors' voice" advocated by ANT scholars and *mapping controversies* approach (see Chapter 3), it means of course that **the research is a slow process of**

finding and passing though many different *gate-keepers* (Lewin 1947; White 1950) that filter the access to information.

Therefore, the unlocking of some information may require a fair amount of time, or some gate might just remain closed. That is what happened, for instance, with one of the possible cases in Utrecht. In that situation, the employees in the local Environment Area presented the case as a very interesting and controversial one and were willing to share information on it. However, it was not possible, during the whole research period I conducted in the Netherlands, to get in touch in any way with either the practitioners (acoustic consultant, architects) or the developers involved in the project, and therefore to build a satisfactory and not partial view on the case.

Moreover, the investigation of case-studies with a very focused perspective on one specific issue, such as environmental noise mitigation in this case, might pose problems when trying to follow controversies as they unroll "in real time", "inthe making". It is known indeed that an architectural project is full of evolving controversy, more often than not. **However, when the study is only interested in specific controversies, they might rest suspended for months.** This is what happened, for instance, in another case-study in Utrecht that was indicated as a potential interesting case, active at the moment, by the local Environment area. After about a month after the meeting in which I was let in on this case, I managed to talk to the architect in charge of the project, just to discover that all the discussions on noise mitigation issues had been suspended as a big part of the project needed to be reorganized due to car accesse~~es~~ and mobility issues.

This may be, of course, incompatible with the time-span in which a research study, such as the one of my PhD, needs to be conducted. Therefore, I opted for a "mixed" approach in the case of Turin, in which interviews on past phases of the projects and archive research mixed with in-field observation and interviews on the active controversies, while for the foreign case-study I had to opt for an already closed process.

Such approaches are not in contrast with the theoretical background in which the work is set, as they have been used in different ANT-based research (Latour 1996; Bradbury 2016; Rydin 2013). Nevertheless, this limitation should be taken into account by researchers wanting to engage with architecture processes under a specific, focused perspective.

Future works and research directions

<u>What kind of policies for the future?</u>

The findings of the work presented in the previous section showed how analysis of real case-studies supported the claim for processes which are more open and complicated at the beginning, allowing to *translate* different requirements into designs which are approved by all the stakeholders, hence avoiding long concerns and negotiations in the following phases.

Moving the issue of noise mitigation to the initial stages of the design, including them in the building design, means allowing architects to repossess their role as crucial mediators of the design process, that allows a response to many different requirements through design solutions.

It has been pointed out in this work how policies can have a crucial role in influencing the enrolment of architects from the initial stages of the process. In particular, *performance-based* policies that only set metrics (in this case, maximum noise levels) to be respected, without translating them into indications or prescriptions related to mitigation solutions design failed to enrol the architect in the noise mitigation issues.

When policies became *prescriptive,* setting limits and indications for the building design, they managed to enrol the architect from the initial stages of the process, acting as intermediary in the informal exchanges between them and the acoustic consultants in defining the building design, hence avoiding time-wasting bureaucratic exchanges with local offices.

On the other hand, when a requirement is transferred from a performance to a prescriptive indications, this can lead to minimum requirements which are quite distant from the living quality goals that were the original aim of the policy. Moreover, requirements that are too prescriptive can lead to the impossibility for architects to define creative solutions that would make it possible to successfully integrate both noise protection goals and other requirements.

Findings from this study therefore suggest that a good solution should be to **maintain a *performance-based* policy, as a general framework, that will pose limits** (in this case, maximum noise levels) related to life quality standards **that will not be abdicated** in favour of minimum prescriptive requirements for the building design.

At the same time, such policies should be accompanied by **guidelines that allow the enrolment of the architect into the process by providing not prescriptions, but indications** on how to respond to noise mitigation requirements through building design. Such guidelines should be considered as a *toolbox*, a catalogue of possible design solutions that could be applied, allowing architects to freely choose and mix them, on the basis of the requirements of the specific project.

Just as in the case of the Municipality of Utrecht, this could be structured in a **two-paces normative evolution**: on one hand the *performative-based* policies, which set more stable and "fixed" standards, and on the other hand the guidelines, which may be defined as *descriptive* policies, to be opposed to the *prescriptive,* strict ones, that will be **more open to modifications**, including new design solutions that can be developed in different contexts, responding to the evolutional drive under which policies are posed by evolving contingencies and design solutions, as we have seen in this work.

What future developments and uses for the visual devices?

As previously pointed out, the visualizations crafted in this study showed good results in enhancing a new perspective on the investigated project, improving awareness on the process within involved stakeholders and interactions and clarifications between them. Therefore, **the results of this study support the advocacy of new visual vocabularies promoted by ANT scholars.**

Moreover, the design of the maps presented in this work, given both the results of the situated evaluation and of the use in a foreign case-study could be **considered as a good starting point for new representations of processes in similar studies.**

The research highlighted the need to disseminate and make available a "body of knowledge" that is constituted by the enormous amount of grey knowledge that is developed in previous processes and that usually lies unshared and unpublished in archives of local offices and private practitioners' studios, in order to allow for more informed choices in the future.

The development of similar visual devices should support the readability of complex processes, hence **enhancing their dissemination, developing a common, shared *visual vocabulary*** to read them.

As far as the **elements to be included in future visualizations** are concerned, this work has shown that **the following elements were useful** in enhancing a new perspective on the process and interactions between stakeholders. Moreover, the use on a foreign case-study has demonstrated that the levels of analysis and representation defined in this study are quite robust for use in different case-studies, hence may be used as **a starting point for future visual devices** (see more in-depth explanation of this in the previous sections of the *Conclusions*):

- Visualization of the "cloud of documents" produced during the process, in relation to the bureaucratic phases of the process;
- Visualization of the time-span of the different *matters of concern,* together with the periods in which they are active or remain latent;
  Visualization of the list of proposed mitigation solutions, with indications on the timeline of the moments in which they were proposed, accepted or discarded, in relation to the bureaucratic phases of the process;
- Visualization of material effects on the project, particularly if put in relation with the acceptance of various mitigation solutions during the time-span of the process;

Both the evaluation with involved stakeholders and the use of maps for the investigation of a second case-study brought to light the need to foresee a further development of the visualization into **more interactive, digital visual devices.**

Such visual devices may be envisioned **as a digital archive which is organized and updated by local offices and made available to private practitioners**, such as architects and acoustic consultants that may navigate through previous projects and also cooperate in the archiving of information for the projects in which they were involved.

This would allow ~~to~~ for a gradual construction of the above-mentioned "body of knowledge".

A first step in the evolution of such visual devices may be a digital platform in which interactive visualizations are constructed through a guided uploading of materials. **Documents produced in a specific process are uploaded and organized by users through the use of "tags" derived from predefined categories of elements** that should be visualized in the maps, such as the one developed in this study (e.g. the type of document, the *matters of concern* that the document mentions, etc.).

However, this would still be an extremely time-consuming method, hence unfeasible, for instance, for local offices that cope with a high number of documents every day.

Therefore, **a second step** in the evolution of the device should be **an automation of the uploading and "tagging" of documents**, for instance through text mining or images recognition tools.

In this case, a **standard layout for the input documents may be defined and adopted by both local offices and practitioners, in order to allow the automatic categorization of documents and of their content** (for instance, a layout for local offices' responses which make them automatically recognizable with respect to technical reports, project drawings, and so on, or the division of documents in predefined sections – such as topic of discussion, sender and consignee of the document, and so on- so that the content of each section can be recognised and tagged automatically).

What roles to envision for the different stakeholders, which indications for researchers?

The scenarios envisioned for future policies and visual devices will define new possible roles and *modi operandi* for various involved actors.

The definition of *performance-based* policies accompanied by more flexible *descriptive* guidelines will enhance, as said, the **role of architects as crucial mediators in the process**.

The guidelines, by guiding architects and acoustic consultants in integrating noise mitigation solutions from the first steps of the process, will allow local offices to indirectly act from the initial phases of the process, hence promoting the inclusion of mitigation solutions without being directly involved in the informal exchanges between practitioners, in which the design is defined.

The role of the **local Environment Area** will be therefore to **design such guidelines** and promote their use by private practitioners. In a first phase they may need to work as a**dvisors to practitioners in the initial phases of the adoption of the guidelines**, until their use is established in practice. Moreover, they will **coordinate periodic revisions of the guidelines,** on the basis of new knowledge emerging from academic research as well as real case studies.

The role of **acoustic consultants** in the process will also be enhanced by the use of guidelines, as it will be possible to be **actively involved in the design process** (as seen in the Utrecht case study) by suggesting possible solutions and supporting architects in preliminary evaluations. They would also **facilitate a more aware evaluation of the possible solutions** on the basis of foreseen noise levels reduction and verification modalities which may influence timing and costs in the process.

Private practitioners such as **architects and acoustic consultants may also contribute to the evolution of guidelines**, by sharing design solutions developed in specific processes, hence contributing to the much-needed dissemination of grey-knowledge put in light by this research.

Finally, the efforts of **academic research** should be directed to support the creation of the guidelines, by systematizing and disseminating findings from existing studies on possible design solutions as well as by conducting new systematic evaluations on new solutions. This would to enhance the pool of possible solutions that can be inserted in the guidelines, as well as their aware evaluation in terms of mitigation results, costs, and other parameters which may be defined.

In addition, **the efforts of researchers should be used to enhance and support the creation of new visual devices**, to be constructed **together with the end-users**

Within such end-users, research should also consider how to take into account the role of citizens, who are ultimately affected by the choices taken during design processes and policies definition, as they will inhabit the results of such choices. Therefore, possible future developments of the work, while placing the specific controversy within a broader view of "meta controversies" to which it is connected (Venturini et al. 2015) may take into account the position and view of inhabitants, while investigating the following phases of the building life or either focusing on processes of participatory design in noise polluted areas.

This may give other important directions for policies and practices in the field, as previous studies applying a similar perspective on public involvement in environmental quality and noise in cities have pointed out how it can affect debate and outcomes.

Moreover, it must be pointed out how similar research should not be limited to noise mitigation aspects. The research methodology used in this study, as well as the indication identified for the development of future visualizations, could apply to investigation for architecture project with respect to policies and requirements in any field (e.g. energy saving, lighting, infrastructure requirements and so on). In future studies, similar processes could be investigated with a broader view on different controversies and not only in relation to a specific issue, in order to shed light on how *matters of concern* related to different aspects and handled by different local offices actually intertwine during the process.

Moreover, an increasing pool of case studies, which, as said, is desirable for the future, should be systematized in a wider panorama in which different cases are categorized on the basis of defined criteria (e.g. different kind of developments according to urban planning laws and policies), allowing the creation of an archive of searchable interactive visualizations (see previous Subsection).

Similar researches should be conducted into multidisciplinary teams, working on collection and analysis of the information and on the definition of digital interactive visualizations. Research projects on longer time spans should also be envisioned. Indeed, as previously pointed out in this conclusions, when analysing strengths and draw-backs of the methodology adopted in this work, adopting a close observation of unpublished case-studies, expecially if they are process which are developing contemporarily to the research studying them, can lead to multiple detours and to the need to pass through multiple *gate-keepers*. Moreover, the observed processes can stay still for long times. Such projects should envision constant cooperation and involvement of stakeholders such as local offices. In such vision, the involved stakeholders would not be involved occasionally for interviews and material requests, but they would cooperate in providing archives of possible case-studies as well as in periodical evaluations and refinement of the visualizations.

References

Alves, Sónia, Beate Altreuther, Joachim Scheuren, Wolfgang Kropp, and Jens Forssén. 2016. *Urban Sound Planning - The SONORUS Project*. *Proceedings of the INTER-NOISE 2016 - 45th International Congress and Exposition on Noise Control Engineering: Towards a Quieter Future*.

Ardeth editorial board. 2018. "Around the Bottega." *Ardeth* 2: 5–11.

Armando, Alessandro, Michele Bonino, and Francesca Frassoldati. 2015. *Watersheds: A Narrative of Urban Recycle*. Guangzhou: Sandu Publishing Co.

Armando, Alessandro, and Giovanni Durbiano. 2017. *Teoria Del Progetto Architettonico. Dai Disegni Agli Effetti*. Roma: Carocci.

Babisch, Wolfgang; Pershagen, Göran, Jenny; Selander, Danny; Houthuijs, Oscar; Breugelmans, Ennio; Cadumd, Federica; VignaTaglianti, Konstantina; Katsouyanni, Klea: Haralabidise, Alexandros S. Dimakopouloue, Panayota; Sourtzi, Sarah; Floudg, and Anna L.Hansellg. 2013. "Noise Annoyance — A Modifier of the Association between Noise Level and Cardiovascular Health?" *Science of The Total Environment* 452–453 (1): 50–57.

Badino, Elena, Roberto Manca, Louena Shtrepi, Cristina Calleri, and Arianna Astolfi. 2019. "Effect of Façade Shape and Acoustic Cladding on Reduction of Leisure Noise Levels in a Street Canyon." *Building and Envionment* 157: 242–56.

Baer, William C. 1997. "Toward Design of Regulations for the Built Environment." *Environment and Planning B: Planning and Design* 24: 37–58.

Baranzini, Andrrea, and Josè V. Ramirez. 2005. "Paying for Quietness: The Impact of Noise on Geneva Rents." *Urban Studies* 42 (4): 633–46.

Basner, Mathias. 2018. "WHO Environmental Noise Guidelines for the European Region : A Systematic Review on Environmental Noise and Effects on Sleep." https://doi.org/10.3390/ijerph15030519.

Basner, Mathias, Wolfgang Babisch, Adrian Davis, Mark Brink, Charlotte Clark, Sabine Janssen, and Stephen Stansfeld. 2014. "Auditory and Non-Auditory Effects of Noise on Health." *The Lancet* 383 (9925): 1325–32. https://doi.org/10.1016/S0140-6736(13)61613-X.

Ben-Joseph, Eran. 2005. *The Code of the City: Standards and the Hidden Language of Place Making*. Cambridge (MA): The MIT Press.

Bentley, Ian. 1999. *Urban Transformations: Power, People and Urban Design*. Abingdon (UK): Routledge.

Beranek, Leo L. 1988. *Acoustic Measurements*. 2nd ed. Mellville (NY): American Institute of Physics.

———. 1993. *Acoustics*. Cambridge (MA): The Acoustical society of America.

Bernard, H. Russell. 1996. "Qualitative Data, Quantitative Analysis." *Field Methods* 8 (1): 9–11.

Bijker, Wiebe E., Thomas Parke Hughes, and Trevor Pinch, eds. 1989. *The Social Construction of Technology Sistems*. Cambridge (MA): The MIT Press.

Bijsterveld, Karin. 2003. "'The City of Din': Decibels , Noise , and Neighbors in the Netherlands , 1910-1980." *Osiris* 18 (2003): 173–93.

Birkbak, Andreas, Morten Krogh Petersen, and Torben Elgaard Jensen. 2015. "Critical Proximity as a Methodological Move in Techno-Anthropology." *Techné: Research in Philosophy and Technology* 19 (2): 266–90.

https://doi.org/10.5840/techne201591138.
Boennec, Rémy Le, and Frédéric Salladarré. 2017. "The Impact of Air Pollution and Noise on the Real Estate Market. The Case of the 2013 European Green Capital: Nantes, France." *Ecological Economics* 138: 82–89.
Boeykens, S., and H. Neuckermans. 2006. "Improving Design Workflow in Architectural Design Applications." *International Journal of Architectural Computing* 4 (4): 2–18.
Bourdieau, Pierre. 1993. *The Field of Cultural Production*. New York (NY): Columbia University Press.
Bradbury, Simon. 2016. "Interrogating the Dynamics of Regulations on the Design of Energy Performance in Housing." *Architecture and Culture* 3 (3): 337–54. https://doi.org/10.1080/20507828.2015.1082059.
Bruun, Henrik, and Janne Hukkinen. 2003. "Crossing Boundaries: An Integrative Framework for Studying Technological Change." *Social Studies of Science* 33 (1): 95–116.
Callon, Michel. 1986a. "Some Elements of a Sociology of Translation: Domestication of the Scallops and Fishermen of St Brieuc Bay." In *Power, Action and Belief: A New Sociology of Knowledge?*, edited by John Law, 184–208. London (UK): Routledge & Kegan Paul.
———. 1986b. "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay." In *Power, Action and Belief*, edited by John Law, 196–233. London (UK): Routledge & Kegan Paul.
———. 1991. "Techno-Economic Networks and Irreversibility." In *A Sociology of Monsters: Essays on Power, Technology and Domination*, 132–61. London (UK): Routledge.
Callon, Michel, Pierre Lascoumes, and Yannick Barthe. 2009. *Acting in an Uncertain World An Essay on Technical Democracy*. Cambridge (MA): MIT Press.
Callon, Michel, and Bruno Latour. 1981. "Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So." In *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*, 277–303. Boston (US) & London (UK): Routledge & Kegan Paul.
Charmaz, Kathy. 2006. *Constructing Grounded Theory. A Practical Guide Through Qualitative Analysis*. London, Thousands Oaks and New Delhi: SAGE.
Cho, Ji Young, and Eun-Hee Lee. 2014. "Reducing Confusion about Grounded Theory and Qualitative Content Analysis: Similarities and Differences." *Qualitative Report* 19 (32): 1–20. https://doi.org/http://www.nova.edu/ssss/QR/QR19/cho64.pdf.
Clark, Charlotte, and Katarina Paunovic. 2018a. "WHO Environmental Noise Guidelines for the European Region : A Systematic Review on Environmental Noise and Cognition." https://doi.org/10.3390/ijerph15020285.
———. 2018b. "WHO Environmental Noise Guidelines for the European Region : A Systematic Review on Environmental Noise and Quality of Life , Wellbeing and Mental Health." https://doi.org/10.3390/ijerph15112400.
Cuff, Dana. 1991. *Architecture. The Story of Practice*. Cambridge (MA): The MIT Press.
Deleuze, Gilles. 1988. *Foucault*. Minneapolis (MN): University of Minnesota Press.
Dewey, John. 2016. *The Public and Itsproblems: An Essay in Political Inquiry*.

Edited by Melvin L. Rogers. Athens (OH): Swallow Press.
Douglas, Ian. 2013. *Cities: An Environmental History*. London: I.B. Tauris.
Droumeva, Milena, and Randolph Jordan. 2019. “Sound, Media, Ecology: Introduction in Three Acts.” In *Sound, Media, Ecology*, edited by Milena Droumeva and Randolph Jordan. Cham (CH): Palgrave Macmillan.
Dunayevsky, Leonid. 2002. “Relation between Dwelling Price and Noise Factor in Moscow.” *Electronic JournalTechnical Acoustics*.
Easteal, Matthew, Simon Bannister, Jian Kang, Francesco Aletta, Lisa Lavia, and H Witchel. 2014. “Urban Sound Planning in Brighton and Hove.” In *Proceedings of Forum Acusticum*, 1–6. Krakov: Hirzel. https://doi.org/10.13140/2.1.2772.0964.
EC. Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 Relating to the Assessment and Management of Environmental Noise. 2002.
Echevarria Sanchez, Gemma, Laura Estevez Mauriz, and Efhstations Margaritis. 2016. “Controlling the Sound Environment.” In *Urban Sound Planning_ Te SONORUS Project*, edited by Laura Estevez Mauriz, Wolfgang Kropp, and Jens Forssen. Gothenburg: Chalmers University of technology.
Echevarria Sanchez, Gemma, Timothy Van Renterghem, Pietr Thomas, and Dick Botteldooren. 2016. “The Effect of Street Canyon Design on Traffic Noise Exposure along Roads.” *Building and Environment* 97: 96–110.
Elo, Satu, and Helvi Kyngäs. 2008. “The Qualitative Content Analysis Process.” *Journal of Advanced Nursing* 62 (1): 107–15.
European Commission. 1996. “Future Noise Policy: European Commission Green Paper.” Luxembourg: Office for Official Publications of the European Communities. https://doi.org/10.3397/1.3703028.
———. 2017. “Future Brief: Noise Abatement Approaches,.” Brussels (BE): European Commission’s Directorate-General Environment.
European Environment Agency. 2010. “Good Practice Guide on Noise Exposure and Potential Health Effects.” Copenaghen (DK).
———. 2014. “Noise in Europe 2014.” Luxembourg.
Fallan, Kjetil. 2011. “Architecture in Action: Traveling with Actor-Network Theory in the Land of Architectural Research.” *Architectural Theory Review* 16 (2): 184–200. https://doi.org/10.1080/13264826.2011.601545.
Felt, Ulrike, Rayvon Fouché, Clark A. Miller, and Laurel Smith-Doerr, eds. 2017. *The Handbook of Science and Technology Studies*. Cambridge (MA): The MIT Press.
Ferraris, Maurizio. 2009. *Documentalità. Perchè è Necessario Lasciar Tracce.* Bari (IT) and Roma (IT): Laterza.
Fountain, Rene-Marie. 1999. “Socio-Scientific Issues via Actor Network Theory.” *Journal of Curriculum Studies* 31 (3): 339–58.
Frampton, Kenneth. 1989. *Modern Architecture: A Critical History*. London: Thames and Hudson.
Free, Edward Elway. 1930. “Practical Methods of Noise Measurement.” *The Journal of the Acoustical Society of America* 2 (18): 18–29. https://doi.org/10.1121/1.1915232.
Frichot, Hélène. 2014. “On the Becoming-Indiscernible of the Diagram in Societies of Control.” *Journal of Space Syntax* 5: 12–13.
Friese, Susanne. 2016. “Computer-Assisted Grounded Theory Analysis With ATLAS.Ti.” In *ATLAS.Ti User Conference 2015 – Qualitative Data Analysis and Beyond*, 1–22. https://doi.org/10.14279/depositonce-5155.

———. 2019. "ATLAS.Ti 8 Windows - User Manual." Berlin (DE): Scientific Software Development GmbH.
Garcia, A. 2001. "Introduction." In *Environmental Urban Noise*, edited by A. Garcia. Southampton (UK): WIT Press.
Gasperoni, Lidia. 2019. "Diagrammatic Practices in Architectural Design." In *Architectural Diagrams 2*, edited by Miyoung Pyo, 2nd editio, 312. Berlin (DE): DOM Publisher.
Geertz, Clifford. 1973. *The Interpretation of Cultures*. New York (NY): Basic Books.
Gisladottir, A. Kirkegaard, P.H. 2017. "Holistic Design Method for the Urban Acoustic Environment." In *Proceedings of the 46th INTER-NOISE Congress*. Hong Kong.
Glaser, Barney G., and Anselm L. Strauss. 1967. *The Discovery of Grounded Theory*. New Brunswick (NJ) and London (UK): Aldine Transaction.
Goffman, Erving. 1974. *Frame Analysis: An Essay on the Organization of Experience*. Cambridge (MA): Harvard University Press.
Goines, Lisa, and Louis Hagler. 2007. "Noise Pollution: A Modern Plague." *Southern Medical Journal* 100: 287–94.
Guest, Creg, Kathleen M. MacQueen, and Emily E. Namey. 2012. *Applied Thematic Analysis*. NWashington DC: SAGE.
Guy, Simon. 2010. "Pragmatic Ecologies: Situating Sustainable Building." *Architectural Science Review* 53 (1): 21–28. https://doi.org/10.3763/asre.2009.0102.
Guy, Simon, and Andrew Karvonen. 2011. "Using Sociotechnical Methods: Researching Human-Technological Dynamics in the City." In *Understanding Social Research: Thinking Creatively About Method*, edited by Jennifer Mason and Angela Dale, 120–33. London: SAGE. https://doi.org/10.4135/9781446287972.n8.
Guy, Simon, and Elizabeth Shove. 2000. *A Sociology of Energy, Buildings and the Environment*. London (UK): Routledge.
Habraken, N. John. 2005. *Palladio's Children. Seven Essays on the Everyday Environment and the Architect.* Edited by Johnatan Teicher. Abingdon (UK): Taylor & Francis.
Haraway, Donna. 1988. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14 (3): 575–99.
———. 2016. "Tentacular Thinking : Anthropocene , Chthulucene." *E-Flux* 75: 1–17.
Hardlooper, J. 2008. "Sound Reduction of Open Noise Screens." *Proceedings - European Conference on Noise Control*, 3487–90. https://doi.org/10.1121/1.2934249.
Heath, Helen, and Sarah Cowley. 2004. "Developing a Grounded Theory Approach : A Comparison of Glaser and Strauss" 41: 141–50. https://doi.org/10.1016/S0020-7489(03)00113-5.
Henderson, Mary Kathryn. 1991. "Flexible Sketches and Inflexible Data Bases : Visual Communication , Conscription Devices , and Boundary Objects in Design Engineering Flexible Sketches and Inflexible Data Bases : Visual Communication , Conscription Devices , and Boundary Objects in Desi." *Science, Technology, & Human Values* 16 (4): 448–73. https://doi.org/10.1177/016224399101600402.
———. 2006. "Ethics, Culture, and Structure in the Negotiation of Straw Bale Building Codes." *Science Technology and Human Values* 31 (3): 261–88.

https://doi.org/10.1177/0162243905285925.
Iandoli, Luca, and Giuseppe Zollo. 2007. *Organizational Cognition and Learning: Building Systems for the Learning Organization*. Hershey (PA): IGI Global.
Imrie, Rob. 2007. "The Interrelationships between Building Regulations and Architects' Practices." *Environment and Planning B: Planning and Design* 34 (5): 925–43. https://doi.org/10.1068/b33024.
Imrie, Rob, and Emma Street. 2009. "Risk, Regulation and the Practices of Architects." *Urban Studies* 46 (12): 2555–76. https://doi.org/10.1177/0042098009344231.
———. 2011. *Architectural Design and Regulation*. Oxford (UK): Wiley & Blackwell.
International Organization for standardization. 2014. "ISO 12913-1:2014 Acoustics - Soundscape — Part 1: Definition and Conceptual Framework."
International Organization for Standardization. 2018. "ISO/TS 12913-2:2018 Acoustics — Soundscape — Part 2: Data Collection and Reporting Requirements."
Jarup, Lars;, Wolfgang Babisch, Danny; Houthuijs, Göran; Pershagen, Klea; Katsouyanni, and 5 Ennio Cadum Ennio Cadum, 6olfgang Babisch, 2 Danny Houthuijs, 3 Göran Pershagen, 4 Klea Katsouyanni. 2008. "Hypertension and Exposure to Noise Near Airports: The HYENA Study." *Environmental Health Perspectives* 116 (3): 329–33.
Kang, Jian. 2005. "Numerical Modelling of the Sound Fields in Urban Squares." *The Journal of the Acoustical Society of America* 117 (6): 3695–3706.
Keegan, Matthew. 2018. "Where Is the World ' s Noisiest City ?," 2018. https://www.theguardian.com/cities/2018/mar/08/where-world-noisiest-city.
Kempen, Elise van, Maribel Casas, Göran Pershagen, and Maria Foraster. 2018. "WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Cardiovascular and Metabolic Effects: A Summary." *International Journal of Environmental Research and Public Health* 15 (2): 1–59. https://doi.org/10.3390/ijerph15020379.
Kraal, Ben. 2007. "Actor-Network Inspired Design Research : Methodology and Reflections." In *Internationl Association of Societies for Design Research Conference*, 1–12. Hong-Kong.
Kracauer, Siegfried. 1952. "The Challenge of Qualitative Content Analysis." *Public Opinion Quarterly* 16 (4, Special Issue on International Communications Research): 631. https://doi.org/10.1086/266427.
Krimm, J., H. Techen, and U. Knaack. 2016. "Tuning Acoustical Façade Design Aiming for a Controlled Influence on the Urban Soundscape." In *45th INTER-NOISE Congress*. Hamburg.
———. 2017. "Updated Urban Facade Design for Quieter Outdoor Spaces." *Journal of Façade Design & Engineering* 5 (1): 63–65.
Latour, Bruno. n.d. "« Visualisation and Cognition : Drawing Things Together »."
———. n.d. "Critical Distance or Critical Proximity ?" unpublished manuscript, available at http://www.bruno-latour.fr/sites/default/files/P-113-HARAWAY.pdf.
———. 1987. *Science in Action. How to Follow Scientist through Society*. Cambridge (MA): Harvard University Press.
———. 1993. *We Have Never Been Modern*. *Noûs*. Vol. 12. https://doi.org/10.1016/0956-5221(96)88504-6.
———. 1996. *Aramis, or the Love of Technology*. Cambridge (MA): Harvard

University Press.
———. 1999. *Pandora's Hope Essays on the Reality of Science Studies*. Cambridge (MA): Harvard University Press.
———. 2004. "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern." *Critical Inquiry* 30 (2): 225–48. https://doi.org/10.1086/421123.
———. 2005a. "From Realpolitik to Dingpolitik or How to Make Things Public." In *Making Things Public-Atmospheres of Democracy Catalogue of the Show at ZKM*, edited by Bruno Latour and Peter Weibel. Cambridge (MA): The MIT Press.
———. 2005b. *Reassembling the Social. An Introduction to Actor-Network Theory*. Oxford: Oxford University Press.
———. 2008a. "A Cautious Prometheus? A Few Steps Toward a Philosophy of Design (with Special Attention to Peter Sloterdijk)." *Keynote Lecture for the Networks of Design* Meeting of the Design History Society Falmouth, Cornwall, 3rd September 2008*. http://www.bruno-latour.fr/node/69.
———. 2008b. "What Is the Style of Matters of Concern?" *Spinoza Lectures at University of Amsterdam*. Assen: Van Gorcum. https://doi.org/10.5749/minnesota/9780816679959.003.0004.
———. 2013. *Cogitamus. Sei Lettere Sull'umanesimo Scientifico*. Bologna: Il MUlino.
Latour, Bruno, and Albena Yaneva. 2008. "'Give Me a Gun and I Will Make All Buildings Move': An ANT's View of Architecture." In *Explorations in Architecture: Teaching, Design, Research*, 80–89. Basel (CH): Birkhäuser. https://doi.org/10.1145/2991079.2991124.
Law, John. 1987. "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion." In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by W. E. Bijker, T. P. Hughes, and T. J. Pinch, 111–134. Cambridge (MA): MIT Press.
———. 2004. *After Method: Mess in Social Science Research*. London (UK): Routledge.
———. 2009a. "Actor Network Theory and Material Semiotics. In (Ed.), T (Pp. 141-158). Chichester: ." In *The New Blackwell Companion to Social Theory*, edited by Bryan S. Turner, 141–58. Chichester (UK): Wiley-Blackwell.
———. 2009b. "The Greer-Bush Test : On Politics in STS." 2009. http://heterogeneities.net/publications/Law2009TheGreer-BushTest.pdf.
Leatherbarrow, David. 2005. "Architecture's Unscripted Performance." In *Perfprmative Architecture: Beyond Strumentality*, edited by Branco Kolarevic and Ali M. Malkawi. New York (NY and London (UK): Spon Press.
Legewie, Heiner. 2014. "ATLAS . Ti – How It All Began . (A Grandfather ' s Perspective)." In *ATLAS.Ti User Conference 2013: Fostering Dialogue on Qualitative Methods.*, edited by Suzanne Friese and Thomas Ringmayr. Berlin: University Press of TU Berlin.
Lewin, Kurt. 1947. "Frontiers in Group Dynamics: Concept, Method and Reality in Social Science; Social Equilibria and Social Change." *Human Relations* 1 (1): 5–41. https://doi.org/10.1177/001872674700100103.
Lewis, Alan. 2015. "Daylighting in Older People's Housing: Barriers to Compliance with Current UK Guidance." *Lighting Research and Technology* 47 (8): 976–92. https://doi.org/10.1177/1477153515571677.
———. 2017. "The Mathematisation of Daylighting: A History of British Architects' Use of the Daylight Factor." *Journal of Architecture* 22 (7): 1155–

77. https://doi.org/10.1080/13602365.2017.1376342.
Linderoth, Henrik C.J. 2010. "Understanding Adoption and Use of BIM as the Creation of Actor Networks." *Automation in Construction* 19 (1): 66–72. https://doi.org/10.1016/j.autcon.2009.09.003.
Lu, S., X. Yan, X. Weigo, Y. Chen, and J. Liu. 2016. "Improving Auditorium Designs with Rapid Feedback by Integrating Parametric Models and Acoustic Simulation." *Building Simulation* 9: 235–50.
Maag, Trond. 2017. "Integrated Urban Sound Planning. From Noise Control to Sound Quality for the Everyday City." In *InterNoise 2017*, 3937–45. Hong Kong: Institute of Noise Control Engineering.
Madsen, Anders Koed, and Anders Kristian Munk. 2019. "Experiments with a Data-Public : Moving Digital Methods into Critical Proximity with Political Practice." *Big Data & Society*, 1–14. https://doi.org/10.1177/2053951718825357.
Mansell, James G. 2017. *The Age of Noise in Britain Hearing Modernity*. Champaign, IL: University of Illinois Press.
Marzi, Claudia, Gabriella Pardelli, and Manuela Sassi. 2011. "A Terminology-Based Re-Definition of Grey Literature." *The Grey Journal* 7 (1): 19–24.
Mattern, Shannon. 2017. "Waves and Wires: Cities of Electric Sounds." In *Code and Clay, Data and Dirt: Five Thousand Years of Urban Media*. Minneapolis (MN): University of Minnesota Press.
———. 2020. "Urban Auscultation; or, Perceiving the Action of the Heart." *Places*, no. 2020: 1–19. https://doi.org/10.22269/200428.
McKenzie, Dan. 1916. *The City of Din: A Tirade against Noise*. London: Adlard & Son, Bartholomew Press.
Mcmullan, Thomas. 2019. "Cities Are Louder than Ever and It's the Poor Who Suffer Most," 2019. https://www.theguardian.com/cities/2019/apr/25/cities-are-louder-than-ever-and-its-the-poor-who-suffer-most.
"Metropolitan Police Act 1839." n.d. Accessed October 30, 2019. http://www.legislation.gov.uk/ukpga/Vict/2-3/47/contents/enacted.
Migneron, J.P., and A. Potvin. 2012. "Noise Reduction of a Double-Skin Façade Considering Opening for Natural Ventilation." *The Journal of the Acoustical Society of America* 131 (4): 3320–28.
Moore, Steven A., and Barbara B. Wilson. 2009. "Contested Construction of Green Building Codes in North America: The Case of the Alley Flat Initiative." *Urban Studies* 46 (12): 2617–41. https://doi.org/10.1177/0042098009346327.
———. 2014. *Questioning Architectural Judgment: The Problem of Codes in the United States*. Abingdon (UK): Routledge.
Munk, Anders Kristian, and Sebastian Abrahamsson. 2012. "Empiricist Interventions : Strategy and Tactics on the Ontopolitical Battlefi Eld." *Science & Technology Studies* 25 (1): 52–70.
Myoungjin, Oh, Shin Kwangsoo, Kim Kyungah, and Shin Jungwoo. 2019. "Influence of Noise Exposure on Cardiocerebrovascular Disease in Korea." *Science of The Total Environment* 651 (2): 1867–76.
Neumann, Peter J, Jordan E Anderson, Ari D Panzer, Elle F Pope, Brittany N D Cruz, David D Kim, and Joshua T Cohen. 2018. "The Cost-per-QALYs Gained and Cost-per-DALYs Averted Literatures [Version 2 ; Referees : 3 Approved] Referee Status : Gates Open Research," no. 0: 1–23. https://doi.org/10.12688/gatesopenres.12786.1.
Newman, Michael, and Daniel Robey. 1992. "A Social Process Model of User-Analyst Relationships." *MIS Quarterly,* 16 (2): 249–66.

Nieuwenhuijsen, Mark J, Gordana Ristovska, and Payam Dadvand. 2017. "WHO Environmental Noise Guidelines for the European Region : A Systematic Review on Environmental Noise and Adverse Birth Outcomes." https://doi.org/10.3390/ijerph14101252.

Nilsen, Per, Gunilla Nordström, and Per Erik Ellström. 2012. "Integrating Research-Based and Practice-Based Knowledge through Workplace Reflection." *Journal of Workplace Learning* 24 (6): 403–15. https://doi.org/10.1108/13665621211250306.

Nold, Christian. 2017. "Device Studies of Participatory Sensing : Ontological Politics and Design Interventions." University College London.

Offenhuber, Dietmar, and Sam Auinger. 2019. "Politics of Sensing and Listening." In *Architecture and the Smart City*, edited by Sergio M. Figueiredo, Sukanya Krishnamurthy, and Torsten Schroeder. London (UK): Routledge. https://doi.org/10.4324/9780429324468-14.

Okasha, Samir. 2006. *Il Primo Libro Di Filosofia Della Scienza*. Torino (IT): Einaudi.

Owen, Ceridwen, and Kim Dovey. 2008. "Fields of Sustainable Architecture," no. November 2015. https://doi.org/10.1080/13602360701865373.

Owen, David. 2019. "Is Noise Pollution the Next Big Public- Health Crisis ?" *The New Yorker*, 2019. https://www.newyorker.com/magazine/2019/05/13/is-noise-pollution-the-next-big-public-health-crisis.

Palmer, J.S. 2014. "Network Mapping of Housing Systems Employing Social Network Analysis Tools: The Case of Medium-Density Dwelling Design in Australia."

Parikka, Jussi. 2012. *What Is Media Archaeology?* Cambridge (UK): Polity Press.

Payne, Lisa. 2017. "Visualization in Analysis : Developing ANT Analysis Diagrams (AADs)." *Qualitative Research* 17 (1): 118–33. https://doi.org/10.1177/1468794116661229.

Pinch, Trevor J., and Wiebe E. Bijker. 1989. "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other." In *The Social Construction of Technological Systems. New Direction in the Sociology of Technology*, edited by Wiebe E. Bijker, T.P. Huges, and Trevor J. Pinch. Cambridge (MA): The MIT Press.

Pinch, Trevor J., and Karin Bijsterveld. 2012a. "New Keys to the World of Sound." In *The Oxford Handbook of Sound Studies*, edited by Trevor J. Pinch and Karin Bijsterveld. New York (NY): Oxford University Press.

———. 2012b. *The Oxford Handbook of Sound Studies*. New York (NY): Oxford University Press.

Puglisi, G., J. Kang, Y. Smyrnova, and A. Astolfi. 2013. "Effect of Vegetation on Sound Fields in Idealised Urban Open Spaces." In *Proceedings of AIA-DAGA 2013*, 1481–84.

Renterghem, Timothy Van, Marteen Hornix, Jens Forssen, and Dick Botteldooren. 2013. "The Potential of Building Envelope Greening to Achieve Quietness." *Building and Envionment* 61: 34–44.

Ricci, Donato. 2010. "Seeing What They Are Saying: Diagrams for Socio-Technical Controversies." In *DRS2010 - Design & Complexity Proceedings*, edited by David Durling, Rabah Bousbaci, Lin-Lin Chen, Philippe Gauthier, Tiiu Poldma, Seymour Roworth-Stokes, and Erik Stolterman. Montreal: Universitè de Montreal.

Roo, Gert de. 2000. "Environmental Planning and the Compact City – A Dutch Perspecitve." In *Compact Cities and Sustainable Development. A Critical*

Assessment of Policies and Plans from an International Perspective, edited by Gert de Roo and Donald Miller. Farnham (UK): Ashgate.

———. 2003. *Environmental Planning in the Netherlands: Too Good to Be True, From Command-and-Control Planning to Shared Governance*. Farnham (UK): Ashgate.

Rucker, A. 1975. “Straßenverkehrslärm in Wohngebieten.” *Kampf Dem Lärm* 22.

Ruiter, Evert Ph.J. de. 2004. “The Great Canyon. Reclaiming Land from Urban Traffic Noise Impact Zones.” Technische Universiteit Delft.

Russolo, Luigi. 1916. *L’Arte Dei Rumori*. Milano (IT): Edizioni futuriste di “poesia.”

Ryan, Mitchell, Michael Lanchester, and Stephen Pugh. 2011. “Noise Reduction through Facades with Open Windows.” In *Australian Acoustical SocietyConference 2011, Acoustics 2011: Breaking New Ground*, 314–21.

Rydin, Yvonne. 2013. “Using Actor-Network Theory to Understand Planning Practice: Exploring Relationships between Actants in Regulating Low-Carbon Commercial Development.” *Planning Theory* 12 (1): 23–45. https://doi.org/10.1177/1473095212455494.

Rydin, Yvonne, Simon Guy, Chris Goodier, Ksenia Chmutina, and Patrick Devine-wright. 2015. “Geoforum The Financial Entanglements of Local Energy Projects.” *Geoforum* 59: 1–11. https://doi.org/10.1016/j.geoforum.2014.11.019.

Ryen, Linda;, and Mikael Svensson. 2015. “The Willingness to Pay for a Quality Adjusted Life Year: A Review of the Empirical Literature.” *Health Economics* 24 (10): 1289–1301.

Sarfatti-Larson, Magali. 1993. *Beyond the Post-Modern Fac°ade: Architectural Change in Late Twentieth Century America*. Berkeley (CA): University of California Press.

Schafer, Raymond Murray. 1994. *The Soundscape : Our Sonic Environment and the Tuning of the World*. Rochester, VT: Destiny Books.

Scheurer, F. 2010. “Materialising Complexity.” *Architectural Design* 80 (4): 86–93.

Scott, H. H. 1957. “Historical Development of the Sound Level Meter.” *The Journal of the Acoustical Society of America* 29 (12): 1331–33. https://doi.org/10.1121/1.1908788.

Seidel, John V. 1998. “Appendix E: Qualitative Data Analysis.” In *The Etnograph v.4 Manual*. Colorado Springs (CO): Qualis Research.

Sidorova, Anna, and Suprateek Sarker. 2000. “Unearthing Some Causes of BPR Failure: An Actor-Network Theory Perspective.” In *AMCIS 2000 Proceedings*.

Signorelli, Valerio. 2017. “Listen through the Map.” In *Urban Design and Representation: A Multidisciplinary and Multisensory Approach*, edited by Barbara E.A. Piga and Rossella Salerno. Cham (CH): Springer.

Silvis, Emile, and Patricia M Alexander. 2014. “A Study Using a Graphical Syntax for Actor-Network Theory.” *Information Technology & People* 27 (2): 110–28. https://doi.org/10.1108/ITP-06-2013-0101.

Sismondo, Sergio. 2010. *Introduction To Science and Technology Studies*. *Bulletin of Science, Technology & Society*. Vol. 5. Hoboken (NJ): Wiley & Blackwell. https://doi.org/10.1177/027046768500500405.

Smilor, Raymond W. 1977. “Cacophony at 34th and 6th: The Noise Problem in America 1900-1930.” *American Studies* 18: 23–38.

Smith, Marc A. 2014. “NodeXL: Simple Network Analysis for Social Media.” In

Encyclopedia of Social Network Analysis and Mining, edited by Reda Alhajj and Jon Rokne. New York (NY): Springer.

Stengers, Isabelle. 2005. "An Introductory Note to An Ecology of Practices." *Cultural Studies Review* 11 (1): 183–96.

Stephan, Peter Friedrich. 2015. "Designing 'Matters of Concern' (Latour): A Future Design Task ?" In *Transformation Design: Perspectives on a New Design Attitude*, edited by Wolfgang Jonas, Sarah Zerwas, and Kristof von Anshelm, 202–26. Basel (CH): De Gruyter.

Thompson, Emily. 2002. *The Soundscape of Modernity. Architectural Acoustics and the Culture of Listening in America, 1900-1933*. Cambridge (MA): MIT Press.

Till, Jeremy. 2009. *Architecture Depends*. Cambridge (MA): The MIT Press.

Tresch, John. 2007. "Technological World-Pictures : Cosmic Things and Cosmograms Technological World-Pictures : Cosmic Things and Cosmograms" 98: 84–94.

Tschumi, Bernard. 1981. *The Manhattan Transcripts, Theoretical Projects*. London (UK).

Tufte, Edward. 2001. *The Visual Display of Quantitative Information*. Second edi. Chershire (CT): Graphic Press.

Venturini, Tommaso. 2010. "Diving in Magma: How To Explore Controversies Using Actor-Network Theory." *Public Understanding of Science* 19 (3): 258–73. https://doi.org/10.22394/0869-5377-2018-5-53-81.

———. 2012. "Building on Faults: How to Represent Controversies with Digital Methods." *Public Understanding of Science* 21 (7): 796–812. https://doi.org/10.1177/0963662510387558.

Venturini, Tommaso, Anders Munk, Axel Meunier, Tommaso Venturini, Anders Munk, Axel Meunier, Data-sprinting Public, Tommaso Venturini, Anders Munk, and Axel Meunier. 2018. "Data-Sprinting : A Public Approach to Digital Research." In *Routledge Handbook of Interdisciplinary Research Methods*, edited by C. Lury, P. Clough, M. Michael, R. Fensham, S. Lammes, A. Last, and E. Uprichard. Abingdon (UK) & New York (NY): Routledge.

Venturini, Tommaso, Donato Ricci, Michele Mauri, Lucy Kimbell, and Axel Meunier. 2015. "Designing Controversies and Their Publics." *Design Issues* 31 (3): 74–87.

Verhoef, E. 1994. "External Effects and Social Costs of Road Transport." *Transportation Research* 28A: 286.

Vermaas, Pieter E., Peter Kroes, Andrew Light, and Steven A. Moore. 2008. *Philosophy and Design. From Engineering to Architecture.* Berlin (DE): Springer.

Wagner, Kate. 2018. "City Noise Might Be Making You Sick." *The Atlantic*, 2018. https://www.theatlantic.com/technology/archive/2018/02/city-noise-might-be-making-you-sick/553385/.

Weber, Miriam. 2013. "Noise Policy: Sound Policy? A Meta Level Analysis and Evaluation of Noise Policy in the Netherlands." Utrecht University.

Webster, John C., and Roy G. Klumpp. 1963. "Articulation Index and Average Curve-Fitting." *Journal of the Acoustical Society of America* 35.

White, David Manning. 1950. "The 'Gate Keeper': A Case Study in the Selection of News." *Journalism Quarterly* 27 (4): 383–90. https://doi.org/10.1177/107769905002700403.

Williams, N., D. Daniel, B. Peters, A. Pena de Leon, J Burry, and M. Burry. 2013. "Fabpod: An Open Design-to-Fabrication System." In *Proceedings of the 18th*

International Conference on Computer-Aided Architectural Design Research in Asia (CAADRIA 2013), 251–60.
Willig, Carla. 2013. "Grounded Theory Methodology." In *Qualitative Research in Psychology*. London (UK): Open University Press.
World Health Organization (WHO). 1999. "Guidelines for Community Noise."
———. 2018. "Environmental Noise Guidelines for the European Region." http://www.euro.who.int/en/publications/abstracts/environmental-noise-guidelines-for-the-european-region-2018.
World Health Organization (WHO) Europe. 2009. "Night Noise Guidelines for Europe."
———. 2011. "Burden of Disease from Environmental Noise. Quantification of Healthy Life Years Lost in Europe."
Wright, Steven. 2016. "Exploring Actor-Network Theory And CAQDAS: Provisional Principles And Practices For Coding, Connecting And Describing Data Using ATLAS.Ti." In *Qualitative Data Analysis and beyond - Proceedings of the ATLAS.Ti User Conference 2015*, 1–31. https://doi.org/http://dx.doi.org/10.14279/depositonce-5153.
Yaneva, Albena. 2012. *Mapping Controversies in Architecture*. Farnham (UK): Ashgate.
Yaneva, Albena, and Liam Heaphy. 2012. "Urban Controversies and the Making of the Socia." *Architectural Research Quarterly* 16 (1): 29–36.
Yang, H. S., J. Kang, and K. Cheal. 2013. "Random-Incidence Absorption and Scattering Coefficients of Vegetation." *ACTA Acustica United With Acustica* 99 (3): 379–88.
Zimmermann, Basile. 2008. "Doing Chinese Studies at the Crossroads of Grounded Theory and Actor-Network-Theory." In *7th International Conference on Social Science Methodology*, 1–6. Naples (IT).
Zuccherini Martello, Nicolò, Patrizio Fausti, Andrea Santoni, and Simone Secchi. 2015. "The Use of Sound Absorbing Shading Systems for the Attenuation of Noise on Building Façades. An Experimental Investigation." *Buildings* 5 (4): 1346–60. https://doi.org/10.3390/buildings5041346.