The Involvement of Creativity in Innovative and Sustainable Processes

The involvement of creativity in innovative and sustainable processes

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Abstract. This contribution is going to provide a dynamic overview of the concept of creative productive thinking, its relationship with design methodologies and possible outcomes. Starting from the nowadays understanding of the concept of creativity, several issues will be tackled in order to reframe the use and the impact that creativity has in sustainable design. In particular, the Systemic Innovation Design Methodology will be highlighted in order to provide the proper tools to the design discipline in the sustainable range of impacts. Moreover, the discipline will be applied to the concept of creativity in order to unpack stereotypes and biases. From the dynamics of collaboration to the processes of problem-setting to the issues of complexity, several elements are going to be shown as strategies, and tools to be integrated into creativity. In a second moment, creativity itself will be defined. Starting from the traditional definition in the field of design, the concept is going to be enlarged — considering other disciplines like sociology and management — in order to provide a more interdisciplinary overview. This will show a better understanding of the role of creative productive thinking in systemic innovative methodology, the educational drive — also in situations of failure — and the impact that can have on social, economic and environmental sustainability. Finally, the contribution will guide towards the understanding of creative productive thinking as a problem-setting — and not just problem-solving — drive, able to shift for sustainable innovation outcomes.

Keywords: Creativity, Open-innovation, Sustainability, Design field, Systemic innovation methodology.

1 Introduction

The 2015 Global Creativity Index (the last updated version available), placed Italy 21^ in ranking due to specific parameters in technology, talent and tolerance (Florida et al., 2015). This is a peculiar vertical consideration of creativity that sets in place a strict and objective confrontation between countries [Table 1.]. However, in a global-

ised context, where boundaries are thinner and thinner, and binomials like talent and technology, talent and tolerance are vague and quickly reconsidered with other more inclusive ones (Panozzo, 2021), a few questions come to mind: can this still be a valuable index? What can be considered creative? How new parameters like innovation and sustainability can be integrated into the process? And finally, what can be the effects of creativity in these processes? In the following passages, these concepts will be taken into account to define a future structure of the analysis. A critical analysis is going to be applied in the dissertation in order to mediate the dialogue between known definitions and new interpretations of the previously mentioned concept, adapted to nowadays perception of the experienced world.
Moreover, this chapter will try to answer what can be the role of creativity — not just as a problem-solving tool, but also as a problem-setting activity able to be integrated into the methodologies as a practised behaviour — since the term itself is commonly applied to specific sectors and not integrated into a wider spectrum. An evident example in the matter is related to the STEM discipline, now STEAM — Science, Technology, Engineering, ART e Mathematics. Commonly valued for technological innovation, these disciplines are not separate compartments of knowledge. In addition, since the integration of the artistic sector, they are becoming more and more a network of competence and hard skills that, if integrated with design tools, those disciplines might be able to provide their full potential (Giaccardi & Redström, 2020).

In the following pages, all these concepts are going to be deepened in order to provide you with a wider understanding of the concepts of innovative and sustainable creative productive thinking. But also the concept itself of creativity and its impact that might have in the Design field, as well as in all the other fields of research and application that usually are neglected or considered marginal in the achieving of creative outcomes.

Table 1. The Global Creativity Index 2015 | Martin Prosperity Institute

Rank	Country	Technology	Talent	Tolerance	Global Creativity Index
1	Australia	7	1	4	0.970
2	United States	4	3	11	0.950
3	New Zealand	7	8	3	0.949
4	Canada	13	14	1	0.920
5	Denmark	10	6	13	0.917
5	Finland	5	3	20	0.917
7	Sweden	11	8	10	0.915
8	Iceland	26	2	2	0.913
9	Singapore	7	5	23	0.896
10	Netherlands	20	11	6	0.889

11	Norway	18	12	9	0.883
12	United Kingdom	15	20	5	0.881
13	Ireland	23	21	7	0.845
14	Germany	7	28	18	0.837
16	Switzerland	19	22	17	0.822
16	France	16	26	16	0.822
16	Slovenia	17	8	35	0.822
18	Belgium	28	18	14	0.817
19	Spain	31	19	12	0.811
20	Austria	12	26	32	0.788
21	Hong Kong	32	32	30	0.715
21	**Italy**	**25**	**31**	**28**	**0.715**
	…	…	…	…	…

2 The theoretical definitions of Systemic Innovation Design

Concerning design-driven innovation, the contemporary state of the art highlights and proposes numerous definitions, theories and methodologies useful for the development of innovative products, services, and/or systems. Isaksen's Creative Problem Solving, Chesbrough's Open Innovation, Katz's New Product Development Funnel, British Design Council's Double Diamond, IDEO's Human-Centred Design, Osterwalder's Value Proposition Design, just to mention a few (Hanington & Martin, 2019).
An innovation — usually associated with technological output — in this context can be identified instead in the process and even in the value generated. For this reason — from now on — it will be more appropriate to talk about Systemic Innovation Design, and its impact on sustainability (Gaiardo et al., 2022). Sustainability is identified in the balance of social, environmental and economic dimensions. (Ukko et al., 2018).

In the contemporary scenario — fluid and constantly changing — a project characterised by a Systemic Innovation mindset, takes the form of a multifaceted force characterised by its inherent dynamism. A force skilled in knowing how to respond actively and proactively to the provocations of the path: we know the starting point but not the end one.
It goes without saying that such complexity can be addressed exclusively starting from a transdisciplinary approach. Systemic innovation Design thus becomes synonymous with positive contamination, participation and collaboration, acting as a common language and shared vocabulary, and as a mediator between different knowledge (Germak, 2008). A fundamental tool to answer real needs and opportunities offered by the context, in an innovative and sustainable way.

Starting from this last statement, a Systemic Innovation designer can acquire a strategic role in reading and understanding a context. A context that becomes at the same time a tool, means and goal, to answer people's needs, acting according to a human-centred point of view. In fact, the goal is not to create new needs to be satisfied, but to become able to read evolutions and changes of the near future, offering contemporary products, services and communication projects. Also, from a preventive perspective.
Again, talking and writing about Systemic Innovation Design means talking and writing about a sustainable and informed model.

Systemic thinking is a mindset, an approach to seeing and talking about real phenomena characterised by complexity and correlation between components. Components, that are seen as sets of correlated elements, and as sets of relationships that are just as important as the components themselves (Bistagnino, 2011). A necessary premise to be applied to the contemporary context: the information and knowledge society. As a matter of fact, the continuous development of new means of information and communication, of new methods and functions, as well as the quantitative change in progress, leads with itself — inevitably — a qualitative change. The information must no longer be considered a static heritage, but raw material used to always create new forms of value, and sources of sustainable and preventive innovation. Information becomes original material in the hands of the designer, useful for best guiding the design choices in complexity.

2.1 Systemic Innovation Design as a creative process

Creative is, commonly seen as synonymous with artistic. However, the erroneous analogy exposed derives from the common opinion of associating, quoting or referring to disciplines such as painting, sculpture, dance, and music with the concept of creativity. On the contrary, what we don't focus on is that this cognitive ability can have much broader and more universal boundaries. Borders are defined by the intersection of technical, procedural and intellectual knowledge, with a high degree of motivation and creative thinking skills.
From the above and from these short premises, we can state that Systemic Innovation Design is a design process strongly rooted in the individual as well as collective, global as well as local creative culture. It is a highly empathic design process, because knowing how to step into someone else's shoes, knowing how to look, speak and listen, is a constant inspiration and stimulus to the creative process.
And it is precisely the final goal that debunks some of the most recurring myths when it comes to creativity: the smarter you are, the more creative you are; young people are more creative than seniors; creativity is only for those "*heroes*" who dare to take risks; creativity is a solitary act (and usually for man only).
These myths, these false myths, are today — finally — debunked thanks to the power of the training act (Burkus, 2013). Myths overcome, also, from the tendency to provide solutions to explicit or latent problems with a new *forma mentis*: an innovative, inclusive, and creative productive thinking, driven by the critical lens of sustainability.

3 What is creativity and how is it connected

What about creativity? Who is creative? Mainly related to the analysis previously made. In the following sections, the analysis will focus on the understanding of the concept of creativity. Moreover, this approach can be interconnected with the human behaviour and actions that are made, not to create an identikit of the creative person, but to frame the potentiality that lies behind. Finally, defining the relationship between creativity and innovative approach, especially in the specific context where the glimpse of creativity is usually unconsidered.

3.1 What is creativity and where does it stand

Usually, when looking at where to start in defining a concept, the dictionary is the go-to solution. In the case of the word creativity, it can be a useful starting point but non a fulfilling one. Treccani points out, can also be defined as "*an intellectual process divergent from the normal abstract logical process*" (Treccani, n.d.). The definition helps to distinguish a very crucial first element: the diversity between abstraction from creativity. Therefore, it helps to set a first milestone. Although everyone has the potential to use the so-called "*creative streak*", there is a need for further effort.
Goleman can come to our help with an answer. He proposes that a creative spirit is in everyone who wants to "*make things better*" and explore new possibilities, which is quite aligned with the previous definition of innovation (Goleman et al., 2001). Creativity can be seen, not just as a simple methodology that can be applied or an intellectual process, but more as a fundamental step in the design process, able to propose impactful solutions for the triad of concepts: people, planet and prosperity.

A definition

Therefore, creativity can be defined as a combination of factors endogenous to the person (Randle & Stroink, 2018). It requires a certain amount of artistic abstraction, and therefore of fantasy, to ignite the emotional spark (Munari, 1977). However, it also requires practical technicality to guarantee concreteness in the elaboration (Ventura *et al*., 2017). In addition, in order for creativity to fulfil the need established upstream, it also requires imagination — systems thinking — in the strict sense of the term (Logan et al., 2021). That is, it needs to project the creative-technical image of the person, within the designated context, receiving feedback that only his imagination is able to read (Shen et al., 2021). Finally, creativity is locally rooted, it is however global in its reach, able to scale-out into a networking and clustering function (EU Commission, 2010).

3.2 What is the role of creativity in systemic and innovative processes

Considering what has been said about creativity, it can't be considered a toolbox or a structured approach like other design methodologies, it became challenging to describe a precise functionality or role in such a specific sector as innovation. Nevertheless, it is evident that its use is fundamental to achieving the outcome required (Baksterville et al., 2016). Therefore, in order to showcase the necessity of its use in inno-

vative methodology, some examples from the past and contemporary literature can be taken into account.

Maldonado case

A master in design, exploration and innovation that can start the dialogue is Tomás Maldonado (1970) in *La speranza progettuale*. Although in his book he doesn't directly mention creativity, oftentimes, he highlights the importance of a strategic revolution of innovation, moving away from the traditional mechanistic approach, and considering more fluid processes that guide the designer as a mediator between social and natural contexts. Moreover, he considered the position of Hannah Arendt, where spontaneous action without programs is the constant of all modern revolutions. Even though he does not fully agree with her position — underlining the necessity of the planning role of a designer since the beginning of the innovative process — considering this alternative position, which can be applied in the design process has its factual relevance.

From its consideration, it emerges the necessity of a disruptive approach in the design methodologies. He also identifies the figure of a "*new utopian"* able to transform disruptive pessimism into constructive pessimism from which to build. This figure, according to his description has to be creative and use the revolutionary drive into innovative and emancipated social projects.

The co-evolution of problem–solving case

The empirical activity performed in the Faculty of Industrial Design Engineering, Delft University of Technology and augmented by Dorst and Cross (2001) showcased the non-correlation between creative design and good design — which, once again, proves that creativity is not an activity defined within a methodology — but more as they mentioned: "*creative design seems more to be a matter of developing and refining together both the formulation of a problem and ideas for a solution".* Therefore, it is more a co-evolution of problem identification — problem-setting — and problem-solving dialogue, that interact simultaneously and constantly within the issue and the actors involved in order to achieve, in the end, good design.

The creative confidence model

Another example that takes into account the integration of creativity into innovation are the new business models based on creative confidence (Kelley & Kelley, 2013). This model takes into account all the elements used in systemic innovative methodologies — design thinking, problem-solving, sprint execution, creative confidence, innovation of meaning and systemic thinking — applied through creativity into social enterprises (Vannini & Piccolo, 2021). Moreover, in this model, it's underlined the importance of creative thinking in dialogue with the more rigid company structure, in order to transform endogenous — and exogenous — communication, creating reticular networks, based on relationships and common languages.

This example provides a valuable milestone in integrating creativity in commonly rigid and structured environments like enterprises. It's, once again, another element in support of the role of creativity in different fields of application.

Finally, this contribution, emphasises another topic, quite relevant to mention in the creative thinking processes: failure and uncertainties. Since the irrationality of creativity, it can occur that this process may lead to no concrete result. Therefore, living and understanding uncertainty, going through judgement — personal and of others — and finally losing control, are crucial elements to consider while approaching innovation — and now we can also mention systemic — methodologies through creative thinking.

From the previous definition of creativity, and the role of the models taken into account, several considerations can be extracted. Creativity has a strong bond with problem setting (Dorst & Cross, 2001) and project development (Maldonado, 1070). It has an active role throughout the systemic innovation methodology, therefore, it can't be limited to one individual step. Moreover, is not just an individual *skill*, but has the potential to create a derogative network (Vannini & Piccolo, 2021). It is a valuable element in organisational settings and team success (Andriopoulos, 2001). Even if success — not as opposed to the concept of failure that we will investigate later — is not necessarily the necessary result to which creativity leads.

All those elements are already somehow part of the Systemic Innovation Design Methodology, but at the same time, they have the potential to be reinforced and scaled up through creative productive thinking. Creativity itself is able to support breaking boundaries and achieving innovative — also sustainable — results (Černe et al., 2022) therefore, the logical integration of this element into an innovative methodology, can provide a drastic shift in outcomes.

3.3 What is the nowadays dialogue and how it can evolve

Creativity can also bring unsuccess. Usually, this is not the aim that a designer would achieve, but it might be appended. As Dorst and Cross (2001) are highlighting, creativity doesn't provide unique solutions — as well a design thinking activity doesn't imply the involvement of creativity.
Therefore, analysing the concept of failure might have a relevant role in understanding the creative process. In the following sub-paragraph, it will be deepened the topic, in order to reach a practical understanding of the creative dynamics and even define creativity as a catalyst in the Systemic Innovation Design Methodology.

The role of failure

When considering the concept of failure, usually there is a strong will of avoiding it. The majority of the time — especially in management or the economic field — there is the prerequisite of creating risk assessment or defining the performance of a process (Espejo, 2000), in order to avoid failure. Moreover, are created frameworks, matrices and flowcharts that identify all the possible threats (Covello et al., 2012). But in considering a Systemic Innovation Design Methodology, avoiding risk is not always the way to reach innovation itself. Logan et al. (2021) underlined the strong value of learning from failure.

In order to improve personal performance, failure has a key role in the framework. As a matter of fact, if failure is combined with creative thinking, it is able to overcome issues and become a way to see the problems — problem-setting — and solve them (Sawyer, 2019). This can reverse the condition, creating from failure new opportunities (Kapur, 2009).

4 Conclusions: creativity as a shift for Sustainable Innovation

Creative productive thinking can be considered, as mentioned previously, to have a relevant role in collective / collaborative activities, and in particular, in problem-setting (Chesbrough, 2003). It is able, through structured methodology — as the Systemic Innovation Design Methodology —, to rich innovative solutions and although failure might occur, educational outcomes can reverse the failed status [Table 2.]. To this, it can be added that the use of creativity in an innovative methodology — or a strategic business application —, can create a radical shift in the value of the outcomes — in this case, sustainable and innovative —, providing new meaning (Wrigley et al., 2021).

Table 2. Central points in problem-setting and problem-solving dynamics

Problem-setting	**Problem-solving**
Scenario analysis and data collection	Problem identification
Opportunities and potentialities definition	Generation of solution
Awareness of human needs and potential	Evaluation
Transdisciplinary approach	Implementation
Creative productive thinking	Testing
Sustainable and innovative outcome	Outcome

Therefore, creative productive thinking can be seen, not just an added element to the Systemic Innovation Design Methodology, but an intrinsic component to the dynamics of investigation, analysis and design development (Gaiardo et al., 2022). Compared to other methodologies such as Concurrent Ecodesign (Micheletti, 1999), or Systemic Design (Bistagnino, 2011) — which can include creative thinking in their process, but is not a fundamental step integrated into the methodology —, The Sys-

temic Innovation Design Methodology sees it as a tool to be applied in order to perform preventive innovation outcomes, from problem-setting to the problem-solving and outcomes assessment.

In collaboration with companies, between universities, individuals or departments, on a practical, theoretical, or even a simple partnership level, — today — promoting open dialogue, and constant interdisciplinary collaboration is a challenge that still encounters some resistance. Learning to deal with complexity, with the coexistence of different points of view, and learning to work in increasingly heterogeneous teams brings with it very specific needs. Paradigms such as open innovation — design hackathons, workshops, etc. —, sharing economy, 5 Rs and circular economy, and partnerships between the public / private sectors, are some of the methods and strategies that apply a collaborative model today. A collaboration aimed at the pursuit of a competitive entrepreneurial achievement not only from an economic point of view, but also from a perspective of environmental sustainability and social inclusion. In other words, a creative achievement.

One last issue to tackle can be identifying the impact of creativity in the methodology. Creativity is a process of idea generation that combines practical, or even technical, issues with a more imaginative approach. In other words, a creative process does not look for a definitive answer, but becomes a powerful tool in the designer's hand, to enable ever-new sustainable development strategies, achieving — also and hopefully — preventive sustainable innovation models. A powerful tool is also useful to manage related risks, and related failures, and develop critical thinking (Deganello, 2019).

References

Andriopoulos, C. (2001). Determinants of organisational creativity: A literature review. *Management Decision*, 39(10), 834–841. https://doi.org/10.1108/00251740110402328.

Baskerville, R., Kaul, M., Pries-Heje, J., Storey, V. C., & Kristiansen, E. (2016). Bounded creativity in design science research. In: *Proceedings of the International Conference on Information Systems*, Ireland, https://core.ac.uk/download/pdf/301370247.pdf.

Bistagnino, L. (2011). *Systemic Design: designing the productive and environmental sustainability*. Slow Food.

Burkus, D. (2013). *The myths of creativity: The truth about how innovative companies and people generate great ideas*. John Wiley & Sons.

Černe, M., Bunjak, A., Wong, S., & Moh'd, S. S. (2022). I'm creative and deserving! From self-rated creativity to creative recognition. *Creativity and innovation management*, 31(4), 664-679. https://doi.org/10.1111/caim.12518.

Chesbrough, H. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business Review Press.

Covello, V. T., Menkes, J., & Mumpower, J. L. (2012). *Risk evaluation and management* (Vol. 1). Springer Science & Business Media.

Treccani Encyclopedia. (n.d.). Creativity in *Treccani Encyclopedia*. Retrieved January 20, 2022. from https://www.treccani.it/enciclopedia/creativita/.

Deganello, P. (2019). *Design politico: il progetto critico, ecologico e rigenerativo: per una scuola del design del XXI secolo* [Political design: the critical, ecological and regenerative project: for a 21st century design school]. Altreconomia.

Dorst, K., & Cross, N. (2001). Creativity in the design process: co-evolution of problem–solution. *Design Studies*, 22(5), 425–437. http://dx.doi.org/10.1016/S0142-694X(01)00009-6.

Espejo, R. (2000, August). Giving requisite variety to strategic and implementation processes: theory and practice. In: *International Symposium on Knowledge and Systems Sciences: Challenges to Complexity. Ishikawa, Japan, Japan Advanced Institute of Science and Technology.* 34-42.

EU Commission. (2010). *Green Paper: unlocking the potential of cultural and creative industries* (B-1049). European Commission, DG Education and Culture. https://op.europa.eu/en/publication-detail/-/publication/1cb6f484-074b-4913-87b3-344ccf020eef/language-en.

Florida, R., Mellander, C., & King, K. (2015). *The global creativity index 2015*. Martin Prosperity Institute. https://budstars.com/martinprosperity/Global-Creativity-Index-2015.pdf.

Gaiardo, A., Remondino, C., Stabellini, B., & Tamborrini, P. (2022). *Il design è innovazione sistemica. Metodi e strumenti per gestire in modo sostenibile la complessità contemporanea: il caso* Torino [Design is systemic innovation. Methods and tools to sustainably manage contemporary complexity: the case of Turin]. LetteraVentidue Ed.

Germak, C. (2008). *Uomo al centro del progetto: design per un nuovo umanesimo* [Man at the center of the project: design for a new humanism]. Allemandi Ed.

Giaccardi, E., & Redström, J. (2020). Technology and More-Than-Human Design. *Massachusetts Institute of Technology Design Issues*, 36(4), 33-44. https://doi.org/10.1162/desi_a_00612.

Goleman, D., Ray, M., & Kaufman, P. (2001). *Lo Spirito Creativo* [The Creative Spirit]. Rizzoli.

Hanington, B., & Martin, B. (2019). *Universal methods of design expanded and revised: 125 Ways to research complex problems, develop innovative ideas, and design effective solutions*. Rockport Publishers.

Kapur, M. (2009). Productive failure in mathematical problem solving. *Instructional Science*, 38(6), 523–550. https://doi.org/10.1007/ s11251-009-9093-x.

Kelley, T., & Kelley, D. (2013). *Creative confidence: Unleashing the creative potential within us all.* William Collins Ed.

Logan, A. T., Moore, A. L., & Bagdy Lauren, M. (2021). K12 Practitioners' Perceptions of Learning from Failure, Creativity, and Systems Thinking: a Collective Case Study. *TechTrends*, 65(4), 636-645. https://doi.org/10.1007/s11528-021-00596-7.

Maldonado, T. (1970). *La speranza progettuale. Ambiente e società* [The design hope. Environment and society]. Einaudi Ed.

Micheletti, G.F. (1999). The Concurrent Ecodesign Methodologies. In: Kuljanic, E. (eds), *AMST '99: vol. 406. International Centre for Mechanical Sciences*, 81–95. Springer. https://doi.org/10.1007/978-3-7091-2508-3_7.

Munari, B. (1977). *Fantasia [Imagination]*. Laterza Ed.

Panozzo, F. (2021). *Cultura e creatività in azienda. L'esperienza del progetto* SMATH [Culture and creativity in the company. The experience of the SMATH project]. franzLAB.

Randle, J. M., & Stroink, M. L. (2018). The development and initial validation of the paradigm of systems thinking. *Systems Research & Behavior Science*, 35(6), 645–657. https://doi.org/10.1002/sres.2508.

Sawyer, R. K. (2019). The role of failure in learning how to create in art and design. *Thinking Skills & Creativity*, 33. https://doi.org/10.1016/j.tsc.2018.08.002.

Shen, S., Wang, S., Qi, Y., Wang, Y., & Yan, X. (2021). Teacher Suggestion Feedback Facilitates Creativity of Students in STEAM Education. *Frontiers in Psychology*, 12. https://doi.org/10.3389/fpsyg.2021.723171.

Ukko, J., Saunila, M., Rantala, T., & Havukainen, J. (2018). Sustainable development: Implications and definition for open sustainability. *Sustainable Development*. 27, 321–336. https://doi-org.ezproxy.biblio.polito.it/10.1002/sd.1904.

Vannini, G., & Piccolo, A. (2021). *Il modello creative confidence. Dall'impresa alla social* enterprise [The creative confidence model. From business to social enterprise]. Libreriauniversitaria.it.

Ventura, M., Lai, E., & DiCerbo, K. (2017). *Skills for today: What we know about teaching and assessing critical thinking*. Pearson Ed.

Wrigley, C., Wolfson, P., & Matthews, J. (2021). Supervising cohorts of higher degree research students: design catalysts for industry and innovation. *Higher Education*, 81(6), 1177–1196. https://doi.org/10.1007/s10734-020-00605-3.