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Systems thinking and its contribution to understanding future designer thinking

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Abstract: Design is changing in a radical way. The object of design is transforming from tangible objects into services and furthermore, into systems. Increasingly, new insights arise from the interfaces between diverse disciplines – such as art, science and technology – which through various discourses and paradigms have been specialized and driven apart. This discussion paper pinpoints the so-called systems thinkers, hybrid-people, whose methods and habits of work are constituted by the reconciliation of different disciplines. The article aims to bring more understanding to the kind of thinking that is needed in the complex and dynamic environment in which we create and use design today. This discussion paper aims to critically understand the advantages and limitations of applying systems thinking to design. The paper attempts to ponder the question of, what a systems view of the world can offer to the future of design thinking.

Keywords: Systems thinking, Designer thinking, Creativity, Multidisciplinary, Future design

1. Introduction – Systems thinking of Leonardo

In the prevailing society, creativity and innovation related skills are becoming ever more crucial for designers. They have to be able to find and solve ill-defined problems in order to create new solutions, products and services, which bring rich experiences, health and well-being to people. Currently, our work-life values specialization. However, as the world grows ever more complex and problems become harder to define, designers need skills to perceive wholes and contemplate phenomena from several perspectives. In addition to specialists, there is a need for generalists, polymaths such as Johann Wolfgang von Goethe or renaissance people like Herbert A. Simon. These kinds of people perceive themselves and the world in a way, which could be quite fruitful for investigating the kind of creative thinking that designers will need in the long term.

In discourse on multidisciplinary creativity, Leonardo da Vinci is often mentioned. He has been described as an embodiment of the blending of art, humanities, science and technology, because of his incomparable multiple abilities. In his time, the renaissance, the fields of art, science and technology were not as separated, polarized and specialized as they are today. Instead, they existed

together in harmony with one another. Despite the prevailing zeitgeist, Leonardo's unique synthesis and appreciation of art, science and technology was not appreciated in his time, but rather was discovered afterwards. (Capra, 2007.)

The main attributes of Leonardo's genius are said to be his exceptional powers of observation and visual memory. He considered the eye as his principle instrument, both as an artist and scientist. His way of working was not towards dominating nature, instead, it was more gentle and multifaceted, emphasizing the intimate connection between the artistic representation of natural forms and the intellectual understanding of their intrinsic nature and underlying principles (Capra, 2016). In fact, the most essential characteristics of Leonardo's science were the science of organic forms and science of qualities. This is fundamentally different from the mechanistic view of for example Galileo, Descartes and Newton. In fact, Leonardo criticized the so-called reductionists of his time in Anatomical Studies, folio 173r:

"The abbreviators do harm to knowledge and to love... Of what use is he who in order to abridge the part of the things of which he professes to give complete knowledge, leaves out the greater part of the things of which the whole is composed?... Oh human stupidity!... Don't you see that you fall unto the same error as he who strips a tree of its adornment of branches laden with leaves, intermingled with fragrant flowers or fruit, in order to demonstrate the suitability of the tree for making planks." (Capra 2016, pp. 7)

Leonardo transcended the disciplinary boundaries by recognizing patterns that intertwined forms as well as processes in different domains. He subsequently integrated his discoveries into a coherent personal vision of the world. For Leonardo, being universal (l'uomo universale) meant recognizing similarities in living forms. Further, he is said to be the first scientist who focused on the interconnecting patterns. (Capra& Luisi, 2014.) Emerging at the forefront of contemporary science is a new systemic understanding, which has discovered the same principles as Leonardo did 500 years ago. This approach is called systems sciences. According to the systems view, "Evolution is no longer seen as a competitive struggle for existence, but rather as a cooperative dance in which creativity and constant emergence of novelty are driving forces." (Capra& Luisi, 2014, xi)

1.1. Systems thinking today – creative dance of multiple disciplines

Even though recently the fields of art, science and technology have been described as separate and distant from one another, there are several similar characteristics – such as the culture of experimentation, discovery, open-mindedness, acceptance of failure and never-ending curiosity towards novelty. At its best, the cooperation of the different disciplines can create memorable experiences, where the elements of different fields are blending fruitfully, such as in Alex Garland's movie *Ex Machina* (2015). Here, dancers express humanity's deep questions about artificial intelligence. There is also Pete Docter's and Ronnie Del Carmen's movie *Inside Out* (2015), where cartoon characters bring light into the science of human emotions. In addition to the communication of scientific discoveries, this kind of knowledge and understanding will be beneficial when the development of robotics, augmented reality, game design, internet of things and new interfaces are blurring the borders of physical and digital environments, and demanding new kinds of understanding to seamlessly orchestrate the creative work of multidisciplinary teams.

As individuals and cultural agents, art, science, and technology are intermingling in all of us. However, the discourse and cooperation between art, science and humanities is not yet mature and active. According to Wilson, Hawkins & Sim (2015), preferable respect for and understanding of the ways of knowing in other disciplines could bring them to a more rigorous and productive cooperation, clarifying the understandings, values and boundaries between the fields. Comprehension of how the axioms and ideological burdens are seen from the perspectives of

different disciplines assists in the unraveling of foundational similarities and widening of perspective and relationships between the fields. In consequence, there could be a richer paradigm of knowledge.

The purpose of this paper is to generate an understanding of both the creative designer, as well as multidisciplinary design discourses as components of one complex system. The interlaced nature between the nodes of this system are becoming more explicit with the spreading of technologies, e.g., artificial intelligence systems such as Watson, demonstrates the interconnectivity of one realm of science, design or industry, to another. That is, food is becoming not simply science but science-design, cars are now robots and augmented reality devices. In a world where technology not only takes over trivial roles but also larger decision-making roles, it is desirable for especially designers, to possess and develop the skills for navigating and negotiating these systems.

In order to do this, the current paper focuses firstly on defining what is meant by a systems view. It then progresses to describe the systems view in creative design thinking. Designers and their thinking are used as focal points in this paper. The idea behind focusing on designers is that while on the one hand, it is a means of narrowing the scope of discussion to an already prominent professional example. On the other hand, design not just as a discipline or professional field, but as a way of thinking, i.e., design as cognition and creative process, permeates across the borders of science, industry and technology. Finally, the paper ponders on question of what a systems view of the world can offer to the future of design thinking.

2. What is a systems view?

Whereas design thinking is an iterative process, resulting in the creation of something new in the world, systems thinking is a way of looking at the world. Systems thinking is said to be a philosophical, as well as, practical perspective, making people think differently about how things work in the world. According to the systems philosophy, problems can be solved and systems can be understood better in the context of relationships rather than in isolation (Bertalanffy, 1967). Therefore, in systems research the focus is on cyclical and dynamic processes rather than on linear causes and effects (Capra & Luisi, 2014). This kind of thinking is based on the philosophical supposition that a system is more than the sum of its parts (Mella, 2012). Subsequently, as an outcome of the interaction of systems, a new phenomenon, action or state of being can be born. This phenomenon is referred to as emergence.

There has been extensive amount of research on systems thinking in the 20th and 21st centuries, but researchers interpret and conceptualize it in different ways. Moreover, its understanding varies significantly between scholars. In this paper, the systems approach is used in its broadest sense, according to which it can be perceived both as a philosophy and a world view (Capra & Luisi, 2014). Research adopting the systems approach differs from traditional research in fundamental ways. Most importantly, the systems conceptualization of life can be seen as a paradigm shift from a mechanistic to a holistic and ecological worldview (Capra & Luisi, 2014).

Presently, systems science is a heterogenic field, in which there are several different approaches. The basis of systems thinking is its diverse theories where phenomena are investigated in multidisciplinary and holistic ways. The aim of systems theories is to model and understand the nature of diverse systems, and to design and redesign the systems by, e.g., changing feedback and interaction dynamics that happen within them. According to Jackson (2003), the purpose of systems thinking is to act as a tool, which fosters creativity through holism which increases when all its methods and perspectives are integrated.

Unfortunately, some systems research is influenced by the overwhelming mechanistic paradigm, which is the main paradigm in the academia. As a solution, Barton and Haslett (2007), suggest reducing the dialectical tensions between the objectivist/analytical and subjectivistic/pragmatic scientific position. A research project that uses real systemic epistemology refers to a strategy of variegation, perspective shifting, pluralism and finally synthesis in order to structure the world in all its complexity (Houghton, 2009). Other key characteristic of systems research are the interplay of paradigm shifting (Shultz & Hatch, 1996), the use of multiple methods (Mingers, 2003), and learning from various methodological and epistemological frameworks (Metcalf, 2005). Systems research acknowledges different ways of thinking, as well as conflict and tension between conceptual frameworks (Houghton, 2009).

2.1. Systems view of creative design thinking

The essence of creativity is both fascinating and frustrating because of its complexity and multifaceted nature. Therefore, defining creativity has been challenging for scientists and sometimes has even been considered a “mission impossible”. This paper will use the systems view of creativity based on Csikszentmihalyi’s (1999) systems model of creativity, according to which creativity is dynamic reflective interaction between an individual, a domain and society. Thus, creativity is seen as a process in the individual and between the individual and society (Gruber & Wallace, 1999).

Creativity is something new and useful (Sternberg, 1999, p. 3). Therefore, it is deeply present in design and design thinking. As an act of creativity, design thinking taps into innate human capabilities; it focuses not only on creating artefacts for humans, but views the creative process itself as fundamentally human. The design process involves multiple complex cognitive mechanisms, because design tasks, particularly wicked problems, often have elements of multiple cognitive domains. Because designing is solution-focused, it aims at discovering new elements and obscurities in the situation at hand and identifying misinterpretations.

When approaching the creativity of designers adopting the systems view, it appears that creativity, discovery and insight are deeply rooted in human biology. We are driven by curiosity, interest and understanding, which have been beneficial for our evolutionary adaptation. In addition, the tools we use are also transforming us. Nietzsche himself noted that when he switching from writing with pencil to typing, his thinking also changed. Since our brain and out mind are plastic, changing all the time, our creations have become a part of our evolutionary development (Carr, 2010).

Creativity has a central - although multidimensional - role in our lives. With creative products, meaning and actions are communicated and transformed. In other words, people create themselves through their use of technology and artefacts (Carroll, 1997). Therefore, when approached from the systems perspective, the creativity of the designers does not end in the design of products. Instead, it contributes to the creative acts of the users and to human evolution overall. On the other hand, people use designs also in ways not intended by the designer – creatively finding new functions and innovations. Design creativity from a systems view, can be seen as a network of creators using each others’ designs as inspiration.

Exceptionally creative people have the ability to present the world to us in a fresh and often surprising way, and create experiences that make our lives rich and enjoyable. They seem to have a talent for looking at things in different ways, which can be seen in their working habits. For example, Wittgenstein (1998) has observed, that work in philosophy, as well as in architecture, is more about working with oneself, with one’s interpretations and perspectives (Pallasmaa, 2012, p. 13). Often, the main obstacle in the endeavour to express creativity comes from our own minds (Jackson, 2003; Robinson, 2011). Systems researchers have identified the main thinking processes that describe

these blocks in our thinking. The central concept is a worldview (*Weltanschauung*), which is an image of the world around us. It contains the selected concepts and the relationships between them, which we use to represent the whole system (Jackson, 2003, p.10). It is a kind of cognitive orientation, which consists of ideas and belief forming descriptions. It can even be described as glasses through which an individual, group, or culture watches and interprets the world and interacts with it.

According to systems researchers, productive and creative action in systems requires a person to become aware of their own mental models, because it supports interaction and communication (Meadows, 2008, p.172). Mental models can be described as internal symbols or representations of external reality. This kind of reflection of worldviews and mental models is important when trying to find new and more creative ways to produce or develop a system. Systems theories argue, that only by changing or considering worldviews and mental models, can we reach the state of deep learning (second-order learning). Otherwise, only superficial learning (first-order learning) is gained (Jackson, 2003; Senge, 1990; originally Argyris, 1977). There are several different ways to foster our ability to see systems and perceive new perspectives. One way to do this is by using systems diagrams and models. In addition, new viewpoints can be gained from stories, visualizations, pictures or songs (Senge 1990, 343). Furthermore, according to systems philosophy, metaphors and paradigms can also be useful for stimulating creativity and gaining new perspectives (Jackson, 2003).

Our perception becomes central when considering systems thinking and design creativity, similarly to how Leonardo considered the eye as his principle instrument in his work in all fields. When highlighting the cognitive aspects of the way our minds work, our previous encounters, experiences and intentions are becoming the main influence on what and how we perceive (Husserl, 1970). This affects, for instance, how we define the whole (system) and how we place boundaries in the system - what we include and exclude from it. This is the critical point where the outer and inner system worlds meet. As Husserl (2001) has pointed out, there is a relationship between the mind and the surrounding world, which is maintained via perception. Thus, the way our understanding is constructed, depends on how we subjectively construct and arrange available information. Moreover, it is not simply based on what we see, but on what we connect to the observed. This form of experiencing can be perceived as a creative process, which is influenced by the above mentioned dimensions and systems.

The creative designer communicates and explains meaning and experiences, and as a result, the creative outcome is a creative experience also for the receiver of the work. Processes and products have the capacity to change the way people think and initiate the creative change of mental models in the receiver and user of the design. Creative practitioners transfer diverse experiences to the receiver by using elements, like metaphors, themes, compositions, and an overall atmosphere of the design that bring about the impact that they want to communicate. Design – when not seen as a mechanistic process where nature's resources and customers' money are used to compete for market shares, but as a creative dance – is a performance where the designer and the user are interacting through a design artefact.

3. Discussion – design and the two cultures

The relationships of different disciplines is not a completely new discussion among academics. The initiator of the discussion of different cultures was C.P. Snow, who pointed out in his lecture (1959), that there are two types of research done in the world - humanities and natural sciences. These two categories complement each other poorly and unclearly, even though they would research the same phenomena (Snow, 1998). Design and artefacts fall into this kind of grey in-between area, because

they are material, non-living things as well as a part of human culture. Therefore, they should include both perspectives in order to gain the best results.

The idea and discussion of two and three cultures in the context of design is not new either. Nigel Cross claims that the third culture is design (or technology), but its position has not been established and articulated thoroughly (Cross 1982). The three culture view presented in Table 1, is a very simple yet useful model to describe the abilities and knowledge of humans (Cross 1982). By understanding different cultures, their focus of study, methods and values, designers can act as bridge builders and connectors who comprehend, move and communicate across the disciplines, talking in different languages. By deeply understanding the different epistemologies of the cultures, designers can move across borders and bring different communities together.

Culture	Phenomenon of study	Appropriate method	Values
Sciences	Natural world	Controlled experiment Classification Analysis	Objectivity Rationality Neutrality a concern for 'truth'
Humanities	Human experience	Analogy Metaphor Criticism Evaluation	Subjectivity Imagination Commitment Concern for 'justice'
Design	The artificial world	Modelling Pattern-formation Synthesis	Practicality Ingenuity Empathy A concern for 'appropriateness'

Table 1 Qualities of three cultures according to Nigel Cross 1982

This paper suggests that in order to be able to integrate different cultures together in design processes, there has to be a unifying philosophy, which acknowledges and supports the existence of the different cultures. Systems philosophy can afford this kind of foundation. This kind of new perspective on creativity and design can give new design and research ideas and possibilities to understand future design thinking, especially in hybrid environments.

In addition to connecting the cultures of knowledge, a systems view offers novel possibilities to analyze design innovation flows. What would a system of innovative international design community look like? A system is an organized whole with interacting parts or units. Between them, these parts provide information transmission and this information flows from one unit to the other, one way or another. The outcome of systems interactions is a goal state, which in the present context could be some kind of design innovation. Thus, a systems view of design thinking enables us the possibility to analyze innovative information flow in a design community.

The elements of the system have the potential to innovate minds and their thoughts. The connection between units would be a worldwide discourse and flow of information. Goal states can be seen as systems of ideas such as products, artefacts, services and other innovations. For example, one idea

developed in Japan can find another idea in Sweden and together they could generate the basis of, for example, a new company.

One could see the worldwide innovation and design process as a heterarchical (as opposed to hierarchical) system of freely floating ideas. The elements of this system would exist on an equal level and be self-organizing. Their combination would be organized by their mutual relevance and the success would be defined by the innovative social value of combinations. At some time, some of the ideas can form a solid system called product. Some other ideas form a different combination leading into another kind of product. Thus, innovation and design as a system of freely floating and relevantly organized ideas can give tools for the investigation of the modern information based innovation economy.

4. Conclusions – What NEXT?

Often systems thinking is seen and perceived only to cover the outer systems e.g. institutions, organizations – social systems or information systems, e.g., software. However, this paper has shown that systems thinking is a more comprehensive and foundational idea. It is a holistic approach, which needs a change of worldview or paradigm shift to be used appropriately. In addition to these so-called outer systems, it should include the inner systems, such as designers thinking, perception and cognition.

There are several ways we can approach and research systems thinking in the context of design. For example, these include: approaching designers' cognition as a dynamic system; approaching the designer – design – consumer interaction as interacting systems; approaching the object of the design as a system; approaching the designer as a systems thinker; and approaching the whole design community as an innovation system.

In this paper I have proposed that we can approach the cognition of designers as a continuously renewing holistic system, and creativity as a dynamic and self-organizing, (not mechanic) process, which is renewing and connected to a wider network system of designers. The possibilities of systems thinking to develop next design thinking is certainly important to research further. If researchers aim at understanding design as a phenomenon more deeply, there is a need for truly multidisciplinary research, and there needs to be a firm philosophical ground for this kind of research. When researching from a systems view, also the researcher should apply systems thinking, because the way researchers perceive design, designers, and the creative process of making and interpreting design, influences the way they conduct research and formulate the research questions asked.

This paper suggests that systems thinking can work as a unifying foundation for designers thinking when connecting the cultures of different disciplines. Practicing designers could benefit from a systems view by understanding more deeply the roots of different disciplines and their cultures, languages and epistemologies. Combining the cultures could bring more relevant, sustainable, creative and emphatic design solutions. Design education could benefit from the systems view by teaching a wider understanding of the world and systems thinking to designers. This type of exploration could eventually provide useful epistemological and ontological insights, which could inform and shape the future lifespan of designers' NEXT thinking.

This paper also stresses that, when applying systems thinking to design or design research, an overall perspective shift is required. Instead of superficially applying methods or tools of systems sciences, more profound philosophical foundation should be utilized. In addition, researchers must ensure that

the methods and tools are in line with the systems philosophy, because it is easy to fall into the mechanistic worldview of the prevailing academic atmosphere.

A systems view could bring change to design, designers thinking and design research by influencing the designers' thought on a deeper and more profoundly philosophical and world view level. Additionally, it can help change perceptions and mental models and by doing so bring about new insights and ideas. Furthermore, a systems view can bring more effectiveness and depth into design. When designers develop their systems thinking skills, they are out of their ordinary thinking patterns, routines and processes, which has the potential to inverse aspects and thus view them in a new light. Systems thinking can bring about practical thinking tools and problem solving strategies that designers would not have thought of otherwise. After all, systems view of life, which encourages individuals to see the interconnecting patterns in all natural things, can work as a design inspiration in itself - just as it inspired Leonardo more than 500 years ago.

References

- Argyris, C. (1977). Double loop learning in organizations. *Harvard Business Review*. Sept-Oct, 115-125.
- Ackoff, R. L., Addison, H. J. & Carey, A. (2010). *Systems thinking for curious managers: With 40 new management F-laws*. Devon. Triarchy Press.
- Barton, J., & Haslett, T. (2007). Analysis, synthesis, systems thinking and the scientific method: rediscovering the importance of open systems. *Systems Research and Behavioral Science*, 24(2), 143-155.
- Bertalanffy, L. (1967). *General Systems Theory: Foundations, Developments, Applications*. New York: George Braziller Inc.
- Boden, M. (2004). *The Creative Mind: Myths and Mechanisms*. 2. Edition. USA: Routledge.
- Buckle Henning, P. & Chen, W-C. 2012. Systems thinking: Common ground or untapped territory? *Systems Research and Behavioral Science*, 29 (5), 470–483.
- Cabrera, D. (2006). *Systems thinking: Four universal patterns of thinking*. Ithaca, NY: Cornell University.
- Cabrera, D., Colosi, L. & Lobdell, C. (2008). *Systems thinking. Evaluation and Program Planning*, 31 (3), 299–310.
- Capra, F. (2007). *The science of Leonardo: Inside the mind of the great genius of the Renaissance*. New York: Doubleday Broadway Publishing Group.
- Capra, F. (2016). *Thinking about thinking: Learning from Leonardo*. Center of Ecoliteracy. Retrieved March 24, 2016 from http://www.uat.edu/webmedia/pdf/Leonardo_14068.pdf
- Capra, F., & Luisi, P. L. (2014). *The Systems View of Life: A Unifying Vision*. Cambridge University Press.
- Carr, N. (2010). *Pinnalliset – Mitä internet tekee aivoillemme*. [The Shallows, What the Internet Is Doing to Our Brains] Helsinki: Terra Cognita.
- Carroll, J. M. (1997). Human-computer interaction: psychology as a science of design. *Annual review of psychology*, 48(1), 61-83.
- Cross, N. (1982). Designerly ways of knowing. *Design studies*, 3(4), 221-227.
- Csikszentmihalyi, M. (1996). *Creativity: Flow and the Psychology of Discovery and Invention*. New York: HarperCollins.
- Csikszentmihalyi, M (1999). Implications of a Systems Perspective for the Study of Creativity. In Sternberg, R. (ed.) *Handbook of Creativity*. New York: Cambridge University Press, 313-338.

- Flood, R. L. (1993). *Dealing with complexity: an introduction to the theory and application of systems science*. Springer Science & Business Media.
- Gruber, H., & Wallace, D. (1999) The case study method and evolving systems approach for understanding unique creative people at work. In *Handbook of creativity*. Sternberg, R. (Ed.) Cambridge: University press. 93-115.
- Houghton, L. (2009). Generalization and systemic epistemology: Why should it make sense?. *Systems Research and Behavioral Science*, 26(1), 99-108.
- Husserl, E. (2001). *Logical Investigations*, Vol. 1. London: Routledge. (First published in 1913)
- Husserl, E. (1970). *The Crisis of the European Sciences and Transcendental Phenomenology*. Evanston: Northwestern University Press.
- Jackson, M. (2003). *Systems Thinking: Creative Holism for Managers*. UK: John Wiley & Sons Ltd.
- Kozbelt, A., Beghetto, R. & Runco, M. (2010). Theories of Creativity. In: *The Cambridge Handbook of Creativity*. Kaufman, J. & Sternberg, R. (eds.). New York: Cambridge University Press, 20-47.
- Meadows, D. (2008). *Thinking in Systems: A primer*. Edited by Diana Wright. USA: Chelsea Green publishing Company.
- Mella, P. (2012). *Systems thinking: intelligence in action* (Vol. 2). Springer Science & Business Media.
- Metcalf, M. (2005, January). Generalisation: Learning across epistemologies. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 6, No. 1).
- Mingers, J. (2003). The paucity of multimethod research: a review of the information systems literature. *Information Systems Journal*, 13(3), 233-249.
- Pallasmaa, J. (2012). *The eyes of the skin: architecture and the senses*. England: John Wiley & Sons.
- Parsons, G. (2016) *The philosophy of design*. Cambridge, MA: Polity Press.
- Robinson, K. (2011). *Out of Our Minds*. United Kingdom: Capstone Publishing Ltd.
- Sawyer, K. & DeZutter, 2009. Distributed Creativity: How Collective Creations Emerge from Collaboration. *Journal of Aesthetics, Creativity and the Arts*. 3(2), 81-92.
- Schultz, M., & Hatch, M. J. (1996). Living with multiple paradigms the case of paradigm interplay in organizational culture studies. *Academy of management review*, 21(2), 529-557.
- Senge, P. (1990). *The fifth Discipline- The Art and Practice of the Learning Organization*. New York: Currency Doubleday.
- Senge, P. (2006). *The fifth discipline: The art and practice of the learning organization*. (2nd ed.) New York: Currency Doubleday.
- Snow, C. P., Collini, S., & Pietiläinen, K. (1998). *Kaksi kulttuuria*. [The Two Cultures] Terra cognita.
- Sternberg, R. J., Ed. (1999). *Handbook of Creativity*. Cambridge: Cambridge University Press.
- Sternberg, R. & Kaufman, J. 2010. Constraints on Creativity: Obvious and not so Obvious. In Kaufman, J. & Sternberg, R. (eds.) 2010. *The Cambridge Handbook of Creativity*. New York: Cambridge University Press, 467-482.
- Stowell, F. A. & Welch, C. E. 2012. *The manager's guide to systems practice: Making sense of complex problems*. Chichester: John Wiley & Sons.
- Wilson, B., Hawkins, B., & Sim, S. (2015). Art, Science and Communities of Practice. *Leonardo*.

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