

- II Suoheimo, Mari, 2019. "Strategies and Visual Tools to Resolve Wicked Problems." *The International Journal of Design Management and Professional Practice* 13 (2): 25–41. <https://doi.org/10.18848/2325-162X/CGP/v13i02/25-41>, ISSN: 2325-162X

This article has been translated from Portuguese to English, and it has been adapted, updated, and refocused from an article published in *Educação Gráfica*, ISSN 2179-7374, open access (Suoheimo 2016).

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Strategies and Visual Tools to Resolve Wicked Problems

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Abstract: Contemporary design has extended its borders from information, product, and service design to tame wicked problems. This article sees it as important to equip design professionals with tools designed specifically for wicked problems, as using tools for simple problems for wicked ones may hinder the process. This is even more important today as designers, especially in the fields of service, social, and transition design, face more and more social issues that are wicked in their nature. Through literature review, it was sought to understand the characteristics of the wicked problems and the visual tools to tame them, like Mess MappingTM, Dialogue Mapping, General Morphological Analysis, and others. One of the findings is that designers should play a collaborative and intermediary role in a group solving/taming wicked problems. This article stresses the importance of a collaborative strategy in wicked problem solving in comparison with competitive and authoritarian strategies. It is important to recognize the role of design in addressing contemporary problems that acquire change. Based on the analysis of the tools, future studies in the area are recommended: to improve the visual ergonomics of the tools; compare the tools designed exclusively for the wicked problems with the ones that can also be used for simple problems; and discuss in the future how these tools work in collaboration with listening and empathy. This is also important because, after all, these tools are all related to complex stakeholder management. Designers should also be better equipped with organizational change and management studies.

Keywords: Wicked Problems; Visual Tools for Wicked Problems; Collaborative, Competitive and Authoritarian Strategies

Introduction

The increasing complexity of contemporary problems demands an increasingly strategic and multidisciplinary design approach. It begins with the delimitation of the problem(s), seeking to identify and characterize their origins and consequences, as well as their context, impact, and interrelations with other possible problems. Buchanan (1992) describes design as a flexible and expanding activity of meaning and connections. The author writes about the history and evolution of design through a literature review and concludes that the areas of design today are: 1) visual communication and information design (graphic design); 2) material objects (product design); 3) organized activities and services (service design); and 4) complex systems or environments for housing, work, play, and education (wicked problems) (Buchanan 1992). The third area consists of the processes of somewhat logical decisions and strategic planning and the fourth we can understand as wicked problem solving (Buchanan 1992). Buchanan (1992) in this landmark article wanted to restore the design discipline as a solver of contemporary problems. Today's contemporary problems are wicked if we think of the famines, social exclusion, wars on terror or poverty as some examples. Meroni (2008) also writes about changing the focus of user-centered design to the community to understand social behaviors, and wicked problems are social in their nature (Rittel and Webber 1973). Wicked problems are unsolvable, impossible problems first defined by two Berkeley university professors, Rittel and Webber (1973).

Problem

There are different strategies developed for wicked problems and ways of how to address them. According to Roberts (2000), one can use authoritarian, competitive, or collaborative strategies. Authoritarian strategies usually involve one or a very specific group who decides for others, often without hearing their opinion (Roberts 2000). Competitive strategies involve different decision makers who work in competition with each other (Roberts 2000). Collaborative

strategies make decisions in collaboration with the stakeholders relevant to the problem being dealt with (Roberts 2000). Grint (2010) points out that authoritarian strategies should be used for simple or critical problems, and for him, the level of collaboration is most evident in wicked problems. From the strategies' perspective, it is interesting to see which of the three is the most adequate with the visual tools for wicked problems found in the bibliographic research.

Wicked problems are much more special and different in comparison to simple or complex problems. They cannot be solved with tools that are not designed for them or otherwise it would be a painful process and it could go wrong (Seybold 2013; Camillus 2008). There are several visual tools that can help to find a solution or resolution to a wicked problem. A literature review is done to find the existing visual tools developed for the wicked problems. This article discusses those tools that have been designed especially for wicked problems and have a need for visual and or graphic illustration.

Goals—Objectives

The reason to do this literature review is to provide tools for designers when addressing socially complex and wicked problems. More future studies have been required, especially in the service design field, to address complexities (Sangiorgi 2009). Design has been expanding more toward the social issues (Norman 2015; Jones 2014; Jones and van Patter 2009) and wicked problems are social (Horn and Weber 2007; Rittel and Webber 1973). With this new positioning of design as a mediator of social issues, it makes this literature review even more important for introducing the tools already available to the design community. This article wants to enforce that the involvement of designers is important when applying the tools, as they are trained to show concepts in images and also have the ability to create ideas (Blyth and Kimbell 2011), and probably faster than other participants and in larger quantities in a wicked problem project. The focus is on the tools and not in the methods such as Design Thinking or Soft Systems Methodology. These tools could be applied in using these methods.

The literature review also shows several authors who recommend that designers should be positioned as facilitators and visualizers of the wicked problems solving process (Howard and Melles 2011; Blyth and Kimbell 2011; Brown 2008). At the same time as the article is searching for the tools, it also tries to reflect on what type of strategic position each tool presents, in the light of Roberts' (2000) authoritarian, competitive, or collaborative strategies. Design is also strategic and managerial when addressing problems, and it is interesting to know in this light what role a designer could play when applying each tool.

Thus, the present article seeks to:

- a) define what a wicked problem is and what the different types of problems are, according to the level of complexity;
- b) present and analyze visual and graphical tools for wicked problem solving;
- c) analyze which of the authoritarian, competitive, or collaborative strategies best serve the visual tools presented in the article;
- d) describe the role of a designer in visualizing and mediating the projects that seek to tame wicked problems from the perspective of the tools and strategies presented.

Typology of Problems

Rittel and Webber (1973), and later Roberts (2000) and Head and Alford (2008), classify problems according to their complexity and harmfulness. This way, they consider the simple ones to be less harmful and the so-called wicked problems to be more damaging (Head and

Alford 2008). Head and Alford (2008, 2013) talk about the typology of problems, dividing them into different categories: Type 1, 2, and 3. The authors use the parameters suggested by Heifetz (1994) to define the different types of situations that a problem may present. Type 1 problems in their nature are simple, in cases when problem definition and solution are known to decision makers (Head and Alford 2008, 2013; Heifetz 1994). According to these same authors, Type 2 situations are problems that have a clear definition but not a solution (Head and Alford 2008, 2013; Heifetz 1994).). Also, in these cases, the cause-and-effect relationship is difficult to distinguish (Head and Alford 2008, 2013; Heifetz 1994).

Table 1: Typology of Problems

DIVERSITY →	1. SINGLE PARTY AS ALL SHARE THE SAME OPINION OR GOAL	2. MULTIPLE PARTIES, EACH HAVING ONLY SOME OF THE RELEVANT KNOWLEDGE	3. MULTIPLE PARTIES, CONFLICTING IN VALUES/ INTERESTS
COMPLEXITY ↓			
A. BOTH PROBLEM AND SOLUTION ARE KNOWN	1	2	3
B. PROBLEM KNOWN, SOLUTION NOT KNOWN (RELATIONSHIP BETWEEN CAUSE AND EFFECT UNCLEAR)	4	5	6 Wicked problem
C. NEITHER PROBLEM NOR SOLUTION ARE KNOWN	7	8 Wicked problem	9 Very wicked problem

Source: Based on the model of Head and Alford 2008

Table 1 presents the different types of problems through diversity and complexity (Head and Alford 2008). Complexity is when a problem and its solution is either known or not known to the participants (Head and Alford 2008). Diversity defines whether participants of the process share the same goal and opinion (Head and Alford 2008). Thus, complexity versus diversity are the aspects that define when a problem is simpler or more wicked. In Table 1, the problem is more complex when it gets closer to the lower right side, and simpler when it gets closer to the upper left side. For example, a very simple problem would be when everyone shares the same opinion regarding the problem and its solution is known to the participants. On the other hand, a more (super) wicked problem of the framework is when the participants are divided and have conflicting interests and neither the problem nor the solution is known in advance. The wicked problems, Type 3, are the numbers 6, 8, and 9 presented in Table 1. For Type 2, the complex problems should go under the numbers 3, 5, and 7. The simple Type 1 would be the rest.

Roberts (2000) confirms the typology of Type 1, 2, and 3. She thinks that the simple problems are Type 1 problems, Type 2 are complex, and Type 3 are wicked. Roberts (2000) is known for working with super wicked problems, such as restoring Afghanistan after the war. Complex problems and wicked problems share similarities, but they are still different.

The Nature of Simple Problems in Relation to Wicked Problems

Problems classified as simple in their nature have a clearer and more direct solution. It is possible to create a definition of the problem and think about how to solve it. To solve these problems, the process often includes three phases: understanding the problem, drawing up a plan, and implementing the plan (Kimmel, Kimmel, and Deek 2003). We could define issues as simple

problems, such as “improving shower usability,” “reducing production costs,” or “designing a door handle.” Wicked Problems in their nature are much more complex (Ritchie 2013; Rittel and Webber 1973).

Rittel and Webber (1973) prefer to speak of resolutions rather than solutions because there are no solutions for wicked problems. It is hard to find proper vocabulary while writing about wicked problems. The word “solution” is being used often now, but one should bear in mind that there are only optimal resolutions, as there are no actual solutions for a wicked problem. Rittel and Webber (1973) were the first to define the wicked problem in their article “Dilemmas in a General Theory of Planning.” Wicked problems commonly occur in areas such as public and economic policy planning (Koppenjan and Klijn 2004). Problems in these areas are more complex because they do not remain stagnant, due to the fact that they change constantly. Such problems could be “mental health,” “immigration plans,” or “urban planning,” issues that do not have any right or wrong answers (Ritchie 2013; Rittel and Webber 1973). Looking closer at the characteristics of the simple and wicked problems, we can better understand how they are formed and tamed. Rittel and Webber (1973) have appropriately defined these wicked problems as “stubborn” because they are difficult to formulate (Rittel and Webber 1973). One should also be aware that a wicked problem could arise from another wicked problem (Rittel and Webber 1973).

Table 2: General Characteristics of SP and WP

GENERAL FEATURES	
Simple Problem - SP	Wicked Problem - WP
Has a relatively well-defined and stable problem statement, for example: “How can we improve the usability of the shower?.”	It is difficult to define what the problem is, as it is unknown and/or stakeholders have conflicting ideas of what the problem is, for example: “How should we fight against terrorism?.”
It has a definite ending point; the participants know when a solution is reached.	For wicked problems, there are no solutions, because there is often little consensus on the problem. Sometimes new problems arise when trying to tame them.
There is a solution that can be objectively assessed as being right or wrong.	Has no right or wrong response and is often influenced by stakeholders, their views, and interests.
It belongs to a class of similar problems, which can be solved in an equal way.	A wicked problem is usually an agglomeration of different kinds of problems, which are not stable.
It has solutions that can be tried and abandoned.	By studying the problem, it is possible to control it, but there is no solution. Attempts to tame this kind of problem bring more knowledge about it.

Source: Adapted from Ritchey 2013

SPs (Simple Problems) have a good definition, but WPs (Wicked Problems) are confusing because they are an agglomeration of problems. A designer of a SP knows when they have achieved the result. A solution to a SP can subsequently be found through research and definition of the problem. In contrast, WPs do not have a linear form of definition, even if they are studied and investigated; there is no solution to the problem (Ritchey 2013).

When the researchers define a SP, they at the same time define the validation parameters of the results, whether they are right or wrong. This is almost impossible for a WP because the solutions are not right or wrong, as already said (Rittel and Weber 1973). The stakeholders are the ones who often define the parameters, a notion of what is the best resolution, and this is what defines the progress of a wicked problem project (Rittel and Webber 1973). Knowledge about other SPs in the same field and how they have been solved earlier will help to solve SPs. There is a pattern that can be replicated. In the process of trying to solve a WP, there can be a trap; equal results cannot be obtained (Rittel and Webber 1973).

According to Ritchey, complex problems are about people and “more complex adaptive systems, which we know” (Ritchie 2013, 3). Humans and societies are subjective. Sometimes, when trying to provide a short-term response to a WP, it can aggravate the problem (Conklin 2008; Ritchey 2013). For some wicked problems, there are no solutions because there is often little consensus on what the problem is, and new WPs often arise when trying to resolve an existing one (Rittel and Webber 1973). Any attempt to solve a WP is valid because it brings more knowledge (Rittel and Webber 1973; Ritchie 2013). Groups that try to solve WPs often feel frustrated and fail to make any progress (Horn and Weber 2007). It may also be that the group does not have enough time, resources, or patience and thus ends up accepting the resolution, considering it sufficient to continue (Rittel and Webber 1973).

Table 3: Summary of the Ten Wicked Problem Points

POINTS	DEFINITIONS
1.	There is no definite formulation of a wicked problem.
2.	Wicked problems do not have a “final solution” because the resolution can always be improved.
3.	Solutions to wicked problems are not true-or-false, but good or bad.
4.	There is neither a final test nor an immediate solution to a wicked problem.
5.	Each solution tentative to a wicked problem is a “one-time operation” and each attempt counts significantly.
6.	Wicked problems do not have enumerable sets of potential (or exhaustively descriptive) solutions.
7.	Each wicked problem is essentially unique.
8.	Each wicked problem can be considered a symptom of another problem.
9.	The existence of discrepancies in the representation of a wicked problem can be explained in several ways. Choosing an explanation determines the nature of the problem resolution.
10.	The planner has no right to be wrong, because there are consequences.

Source: Adapted from Rittel and Webber 1973; Ritchey 2013; Horn and Weber 2007

Strategies for Solving Problems

This literature review seeks to present strategies focused on WPs in order to better resolve them. There are different authors who propose special strategies for the resolution of WPs. This article, presents the leadership strategies of Nancy Roberts and Keith Grint. These authors were selected, among others, because they consider wicked problems when discussing the strategies. According to Howard and Melles (2011) designers should play the role of facilitator in WP resolution processes, and this requires strong leadership with a strategy.

Nancy Roberts (2000) presents three types of strategies for solving a WP: authoritarian, competitive, and collaborative. In authoritarian strategies, power is placed in the hands of few

people and they define the best resolution from their perspective. Roberts (2000) calls this strategy a way of simplifying a WP, but it does not solve it. When fewer people are involved, decision-making is faster as a process, but this requires others to agree on the resolution. The disadvantage of this is when decision makers may be wrong (Roberts 2000).

Competitive strategies have a long history and are used in the fields of politics, war, or even commerce (Roberts 2000). The strategy is based on the principle of seeking power against resistance (Roberts 2000). According to the author, especially in the field of commerce, this strategy works well, because when one company creates an innovation, it creates a need for a rival company to create a better innovation to overcome the competition (Roberts 2000). The advantages of this strategy are several; for example, in the industrial area, this incites more competition in the way of looking for new ideas (Roberts 2000). In this case, power is circulating among the parties involved. For example, one day one entity can win, and the next day another (Roberts 2000). This, according to Pfeffer (1992), avoids the centralization of power, and he sees that the concentration and institutionalization of power is dangerous. The disadvantage of the competitive strategy is that in its course, it can cause violence or even wars between the parties involved (Roberts 2000).

Collaborative strategies start from the principle of working together, and the situation is a win-win and not a win-lose, which is typical for a competitive strategy (Roberts 2000). Joint ventures, partnerships, or alliances are ways of finding collaboration, e.g., in government, business, or international relations (Roberts 2000). According to Yves and Hamel (1998), if two competitors work together, they can find better products or services. The disadvantages of collaborative work are that it requires more time, more people, more meetings, and thus more resources (Roberts 2000). Roberts (2000) also states that collaboration is an acquired gift and needs practice.

There is also another researcher in the area of WPs called Keith Grint, who is focused on the ways of approaching a WP. Grint (2010) scales the problems as critical, tame, and wicked. According to him, the simple or critical problems need an authoritarian strategy (Grint 2010). In fact, the time spent in making decisions in a group could be detrimental; for example, in a train crash there is no time to keep discussing what is the best approach for the problem, because immediate action is needed as lives are at risk (Grint 2010). Critical or simple problems in their nature are self-evident and there is not much uncertainty about what should be done. A tame problem for Grint (2010) may be complex, contrary to Head and Alford (2008, 2013).

For Grint (2010), the level of collaboration increases the more wicked a problem is. In this process, it is important to ask questions and involve all stakeholders, and it is necessary that everyone share the responsibility for resolution. For the WPs, there are no elegant solutions but clumsy ones, and Grint (2010) emphasizes acceptance of the imperfection of the result. There is no guaranteed method, but there is certainty that the different parties need to collaborate to find a better resolution. It should also be understood that no one has an isolated resolution, as a WP is part of a larger system (Grint 2010).

In the light of the literature review, the two authors Roberts and Grint, with great experience in handling wicked problems, stress the importance of using the collaborative strategy as the right approach for a wicked problem resolution process. This is something for designers to bear in mind when handling and facilitating wicked problem projects.

Bibliographical Review of the Visual Tools to Resolve WPs

I see a need for providing a literature review of wicked problem tools, as it gathers the existing tools in one place. It is also a way to better enable designers to work with properly designed tools to address complex wicked problems. Sangiorgi (2009) points out in future studies especially connecting more research of complexities within service design framework. Also, an area where design is expanding more and more is social design (Norman 2015; Jones 2014; Jones and van Patter 2009). I believe that service design, social design, and new transition design (Irwin et al.

2015) are probably the areas that will most benefit from the use of these tools. For sure there are also other areas that handle complexities and wicked social issues beside these ones.

Several authors confirm that it is difficult or impossible to address WPs with tools that have not been assigned to them (Seybold 2013; Camillus 2008). “It is painful to try to solve a complex problem using tools and approaches that are designed for simple problems” (Seybold 2013, 2). There are several types of tools and methods that a team can obtain for WPs. Design thinking is probably one of the most common and famous methods in the field of design in solving problems. It is a peculiar method used for both simple and wicked problems (Blyth and Kimbell 2011; Brown and Wyatt 2010; Brown 2008; Buchanan 1998). This article does not deal with Design thinking, Double Diamond, and Soft Systems Method, as they are methods; this article concentrates on tools. These tools could be used together with these methods in a certain phase. For example, Mess MappingTM has been suggested to be used with Double Diamond in the discovery phase of the problem (Suoheimo and Miettinen 2018). This could also be very well applied to design thinking, as it departs from the principle of resolving problems. Design thinking starts with understanding the problem in order to know how to handle it (Brown and Wyatt 2010). Many who use these methods will gain more profound tools to obtain understanding of wicked problems or how to make better resolutions for wicked problems.

It was not easy to set the parameters for choosing the tools. There are several that were used for simple problems and later were discovered for the WPs. In this article, only the visual tools and the ones that help in the structuring of thought of the drawn and/or computerized form were explored, which were destined exclusively for the wicked problems. It is also important to note that these tools presented here might have been born from other methods, but are solely designed for WPs.

A desktop literature review was performed with words like “wicked problems, and visual presentation,” “tools,” “visual tools,” and with different combinations of these words. Actually, the results for the words “tools” and “visual tools” were the same. Interestingly, all the tools developed for wicked problems are, to some degree, visual. The easiest way of searching was to first map out the tools used for the WPs and then filter the tools designated only for the WPs. It is important to know that there are several other visual tools being used and applied to the WPs, which were not covered in this article because these tools were not designed strictly for WPs. There are also articles about visual tools that are still under development and are therefore not ready for a presentation, which have been excluded from this article. We should not forget that there are plenty of complementary tools like Team Alignment Map or Canvas (Avdiji 2018), which are used to understand the WPs or parts of the problems; they were not designed with the purpose of being a WP tool, so they are not covered here. Also, GIGA Mapping was left out, as after an email with its author, Sevaldson, I learned that it can be used for several types of problems, beside wicked problems, such as simple and complex problems. This article deals solely with tools that treat wicked problems.

Here is a list of the tools that this article will not cover: Team Alignment Map, Canvas, Blueprint, Complexity Based Diagnostic Tool (because it is a blueprint and it is a tool not originally developed for wicked problems), Visual Displays, Uncertainty and Robustness, Visual Interactive Optimization, Release Planning, RAAIS and H+10 model (because they are toolkits with many other existing tools like 5 Whys or Complexity mapping), Gap Mapping, Concept Map, Digital Storytelling, Affinity Diagram, Scenario Planning, Release Planning, Foresight, GIGA Mapping, Forecasting, Collective Competence or Transdisciplinary Imagination (because these last two are not tools, but mindsets). The first literature review was carried out in 2016 and the second one for this article in 2018. Some new tools were found in the context of mapping dialogues and arguments similar to Dialogue Mapping. The next paragraphs will present the tools found.

Mess Map and Resolution Map

Mess Map™ and Resolution Map™ are presented here together because both were created to be used in sequence (Horn and Weber 2007). Mess Map™ is a method that started from scenario planning (Horn and Weber 2007). It is an improved version and it is used to try to create resolutions for WPs. The tools were created by MacroVU(r), Inc. and Strategy Kinetics, LLC (Horn and Weber 2007).

A Mes Map™ may be a bit difficult to understand for a first-timer or outsider of the project, because it can be messy, as the name indicates. But it is possible to try to understand a mess by making a map of it (Horn and Weber 2007). The mess is carefully labeled and structured into parts. Often, a Mess Map™ has groups with different points of view. Inside the map, the team can use pictures, words, and phrases to describe their ideas (Horn and Weber 2007). The arrows between the groups show how views are interconnected (Figure 1.). “We describe social messes as interlinked clusters of problems the group is facing” (Horn and Weber 2007, 9–10).

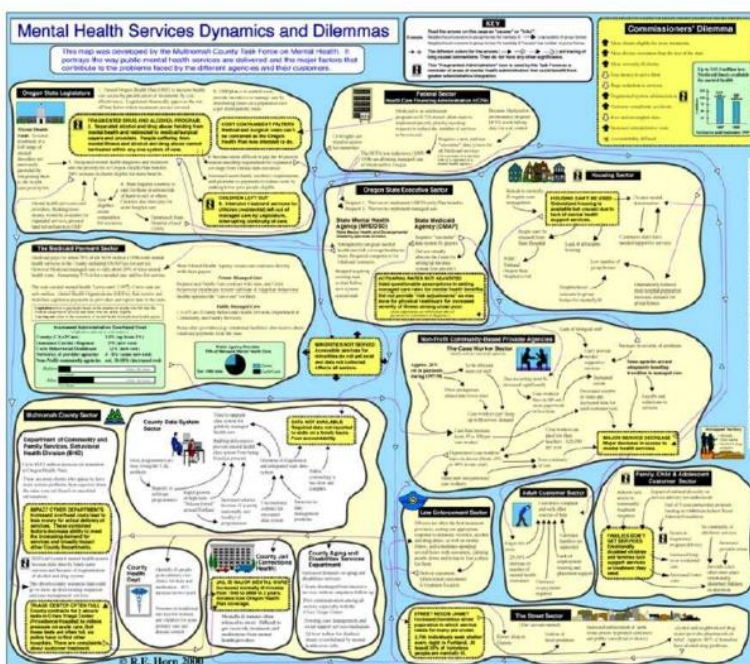


Figure 1: Example of a Mess Map™ - Dilemmas in the Mental Health Service
 Source: Horn and Weber 2007

According to Horn and Weber (2007) the construction of a Mess Map™ is generally organized into four phases:

- 1st phase: facilitators do preliminary research with stakeholders, and often with experts in the field. Interviews serve as a view of a preliminary map.
- 2nd phase: the task of studying the links between problems improves the map with this information.
- 3rd phase: identifies the main influences and causes of interconnected problems and refines the Mess Map™. This phase can be repeated.
- 4th phase: the Mess Map™ is examined to find underlying structural factors. After analysis, you can carry out the planning and implementations.

Mess Map™ helps to visualize the problems and see the necessary connections that through writing only would not be possible (Horn and Weber 2007). The visual connections between the problem areas make it easier to organize and visualize where the team’s effort should be put in order to make changes (Horn and Weber 2007). It is also a useful tool for a new person in the project to quickly understand what is going on by reading the map (Horn and Weber 2007).

Resolution Map™ is a tool used together with Mess Map™ to create scenarios from the problem(s) found (Horn and Weber 2007). The group begins the process by writing end states, which would be the possible futures thinking of what the world is like now and how we got there (Horn and Weber 2007). In this situation, certain events would occur for a scenario to become an end state (Horn and Weber 2007). In the map, according to Figure 2, arrows are placed at the end states for the present, as if the future had already happened. The main focus is to think that the future is now and what happened for it to become what it is (Horn and Weber 2007).

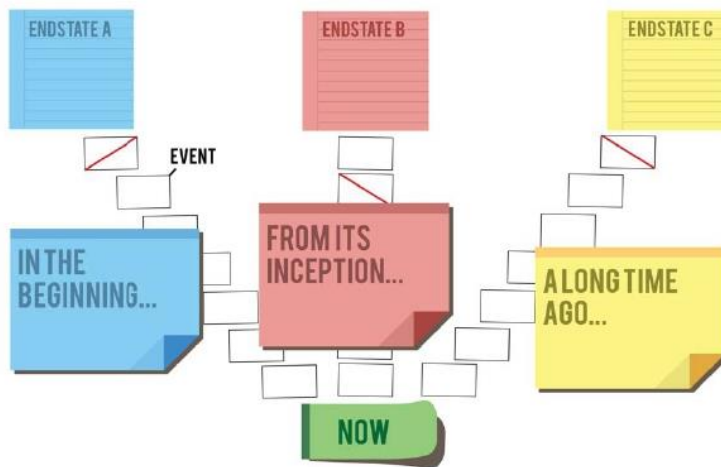


Figure 2: An Example of a Resolution Map
 Source: Adapted from Horn and Weber 2007

There may be several events between the present and the end states, such as the increase in gasoline prices, for example, which are illustrated in the form of boxes in Figure 2 (Horn and Weber 2007). Events help create scenarios that tell stories, and they are told in the form of role-playing (Horn and Weber 2007). A red line on top of an event means that this should not happen (Horn and Weber 2007). It means that it hinders that the desired end state could be reached (Horn and Weber 2007). In the end, it is important to understand the relationship between each end state (Horn and Weber 2007). From this, different action plans will be created on how to handle the WP(s) (Horn and Weber 2007). The benefit of the map is that it does not seek to simplify resolutions but to understand them, and it also identifies individual and organizational responsibilities (Horn and Weber 2007).

Dialogue Mapping and Other Similar Tools

Dialogue Mapping (Seybold 2013), or another similar tool called Issue Mapping (Williams, Johns, and Hakala 2017), allow participants to see the successes and failures of the past, as well as constraints, but it also shows what could work. An interactive screen is needed to create a Dialogue Map, because participants should be able to observe their ideas throughout the dialogue (Seybold 2013). There is a facilitator called a dialogue mapper, who aids in a face-to-face meeting (Seybold 2013). This person often gathers the issues that are being raised throughout the

conversation. By using these procedures, it makes everyone feel that they have been heard, and the first ideas captured can serve as a root for new issues (Seybold 2013).

As Conklin (2008) points out, a shared understanding in a WP-solving project does not necessarily mean that participants agree on the problem. It is important to have dialogue and gain different ways of interpreting a WP (Conklin 2008). As the conversation continues, subjects are annotated on the screen and the arrows visually show the connections of the themes (Seybold 2013). Visualizing the problems will help each one to see their point of view. The map will also help avoid a situation where people who tend to speak more dominate the conversation (Seybold 2013). The map helps people visually and collaboratively view WPs and find where to place resources.

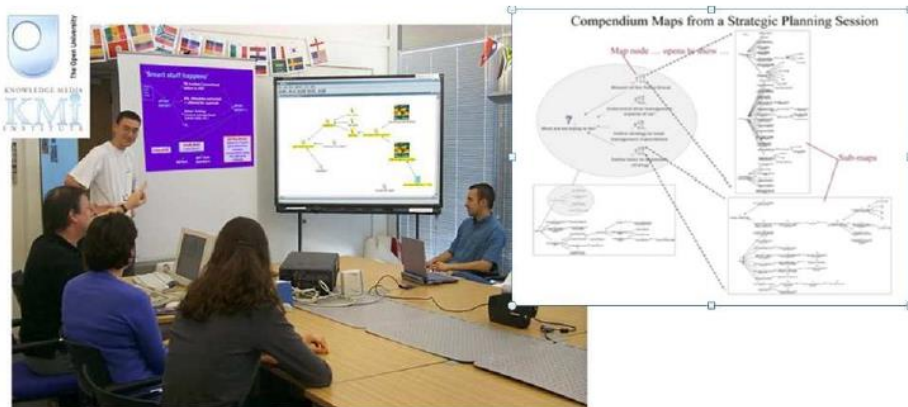


Figure 4: Example of a Dialogue Map Meeting and Results of a Map
 Source: Seybold 2013; http://www.cognexus.org/id41.htm#what_s_it_like__1

Also, Interactive Argumentation or Argument Visualization are tools that are similar to Dialogue Mapping or Issue Mapping (Munneke et al. 2007; Bruggen et al. 2003). They are also made in the form of a dialogue, but start with a claim and then widen the discussion with alternative arguments in the form of a debate (Munneke et al. 2007; Bruggen et al. 2003). All of these tools most probably derive from IBIS mapping that Horst Rittel, one of the authors of wicked problem theory, was developing (Kunz and Rittel 1970). The purpose of IBIS was to aid in political decision-making by mapping issues (Kunz and Rittel 1970). Rittel, together with Kunz, also created a tool called Design Rationale, which is meant to address wicked problems by mapping the reasons behind the problems (Kunz and Rittel 1970).

General Morphological Analysis

Morphological analysis is a method to structure and rigorously investigate a set of relations in WPs (Ritchie 2009). It can be used in scenario development; development of alternative strategies; risk analysis; to relate means and ends in complex political spaces; in the development of models for positional or stakeholder analysis; to evaluate organizational structures; show highly complex relationships in the form of comprehensible visual models (Ritchie 2009). Morphological analysis has a long history, as Goethe had already begun research in this area. Later, several other researchers, such as astrophysicist Fritz Zwicky, refined it in the 1940s (Ritchie 2006). Zwicky’s research influenced engineering design, but later the Stanford researchers found their methods useful in managing and solving problems too, which had not been the initial idea (Ritchie 2006).

General Morphological Analysis works well in constructing future visual scenarios for WPs (Ritchie 2006), but the same model can also be adapted for other purposes. According to

Rosenhear (1996) and Ritchey (2006), the morphological scenario method works well to accommodate several alternatives of perspectives rather than prescribing individual resolutions; through group interaction; generates ownership through transparency; facilitates a graphical (visual) representation of the resolution space; focuses on alternatives instead of continuous variables; and centers on possibilities rather than probabilities.

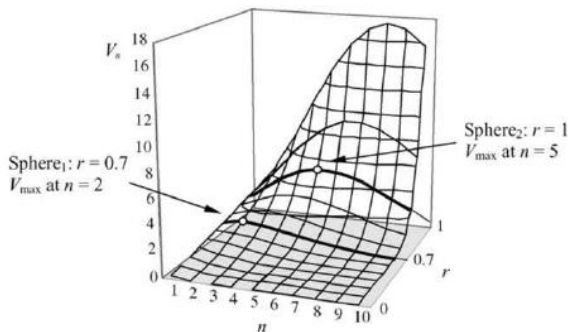


Figure 5: Image Presenting “n” Dimension
 Source: Peli and Brug 2006

Parameter X	Parameter Y	Parameter Z	SCENARIO	EPR rules and regulations	Environmental adaptation of products	Required range of information about products	Waste sorting system	Collection system	Recycling system	Dominant EPR market for waste products	Instruments for deposition and burning
X1	Y1	Z1	Global Crisis (Production gone wild)	Voluntary, branch regulated	Focus on clean materials	Chemicals Material Energy	> 15 commodity groups	Very near premises	Mechanical recycling	International	Recycling: Up Energy: Down
X2	Y2	Z2	Raw Material Depletion	General legislation toward individual. No monopoly	Same as today	Chemicals Material Energy	> 15 material groups	High density "bring system"	Thermal recycling	National and close international	Recycling: Up Energy: Up
X3	Y3	Z3	Current policies (Negative trend)	General legislation toward collective Partial monopoly	Focus on dematerialisation	Chemicals Energy	Same as today	Low density "bring system"	Chemical recycling	Local/regional	Recycling: Down Energy: Up
X4	Y4	Z4	Current policies (Positive trend)	Finely detailed legislation (info, flow & value)		Chemicals only	< 5 commodity groups		Biological recycling		Relative increase of deposition
X5	Y5	Z5	Green-house effect (Stop emissions)				< 5 material groups				
			Batman: High-tech solutions								
			Dematerialised production (New materials)								
			Green market (ideological paradise)								

Figure 6: Morphological Field and Its Application in the Creation of a Discard System of Responsible Packaging in Sweden
 Source: Eriksson and Ritchie 2002; Ritchie 2006

The General Morphological Analysis model in the resolution of WPs creates a shared understanding among the participants (Ritchie 2006). Ritchey (2006) has found through experiments that up to six or seven specialists in a group work well, and in a case that needs more specific knowledge, an expert can be invited to a private session separately. A study, according to the author, can take from two to fifteen days of workshops, and in each workshop up to two facilitators can be used. They help in the process and in the documentation of the session on the computer, which is given to the participants at the end (Ritchie 2006).

According to Ritchey (2006), a morphological field consists of six to ten variables, which in turn can have from 50,000 to 5,000,000 formal configurations. This is an impossible quantity to be managed without help from a computer program (Ritchey 2006). Each pair of conditions will be examined and seen if they can coexist (Ritchey 2006). Using this technique, the morphological field at the end can be reduced in 90 to 99 percent of its size (Ritchey 2006). The computer is used as a field laboratory, which tests initial conditions and examines alternative resolutions (Ritchey 2006).

The analysis begins with defining the most important dimensions in a group and each of the dimensions gains a range of values and conditions (Ritchey 2006). The morphological field is constructed by placing parameters within a table in columns, constructing an “n” dimensional space (Ritchey 2006). An “n” dimensional space is also known as a chaotic area (Dumond at al. 2001). The resolution space of a Zwicky morphological field consists of the subset of configurations, satisfying some criteria, one of which is internally consistent (Ritchie 2006).

Discussion

The Design area continues to evolve and has expanded from graphic, product, and service design to create resolutions for contemporary problems, including WPs (Buchanan 1992). WPs are more complex than simple problems. WPs have ten characteristics in common to be defined as such, according to Table 3 above (Rittel and Webber 1973). In the problem typology, wicked problems are the most difficult, of which Type 3 is the most difficult, but there are also problems that are complex (Type 2), which might have characteristics of WPs, and simple problems (Type 1) (Roberts 2000, Head and Alford 2013).

The literature review found three types of strategies for taming WPs: authoritarian, competitive, and collaborative (Roberts 2000). The authoritarian strategy is faster, and the costs are lower than competitive or collaborative strategies (Roberts 2000). Collaborative strategies help in understanding a problem more widely, as they involve more people (Roberts 2000). A competitive strategy can also decentralize power, but competitive strategies can be dangerous, as they can cause violence or even wars (Roberts 2000). This would not be advantageous in solving a WP. In addition to WPs and the strategies already addressed here, this article also dealt with graphic visual tools, which were exclusively designed for WPs. Through bibliographical research, four tools designed solely for WPs were found: Mess MapTM, Resolution MapTM, Dialogue Map (Issue Map/ Interactive Argumentation), and General Morphological Analysis. However, the tools that could be used for SPs and WPs were left out, because they do not have as a single target to solve WPs.

When analyzing the tools (Table 4) that are presented in this article, the need for a collaborative multidisciplinary team in solving WPs is pointed out. Designers already have this practice in their projects (Conklin 2008; Scariot, Heemann, and Padovani 2012). It is difficult to try to solve a multifaceted problem from only one point of view; a more holistic view is needed. As designers are taught to work collaboratively with different stakeholders, authoritative or competitive strategies may be slightly more difficult to start to work with.

Table 4: Analysis of Visual and Graphical Tools Used Only for WPs

TOOL	Strategy: Authoritarian, Competitive, Collaborative	Hand- drawing/ Computerized	Need for a Visual Designer, Scale 1-5	Designer's Role	GOAL
MESS MAP™	Collaborative	Hand-drawing /Computerized	5	Facilitate the collaborative work and visualize the conversation as well as the map	Understand the problem
RESOLUTION MAP™	Collaborative	Hand-drawing /Computerized	5	Facilitate the collaborative work and visualize the mapping	Resolve the problem
DIALOGUE MAP	Collaborative	Hand-drawing /Computerized	4	Facilitate the collaborative work and visualize the conversation	Understand the problem
GENERAL MORPHOLOGICAL ANALYSIS	Collaborative	Computerized	3	Facilitate and visualize	Understand and resolve the problem

Source: Suoheimo

The typology of the problem (simple/Type 1, complex/Type 2 or wicked/Type 3) should guide when a collaborative, competitive, or authoritarian strategy is better for its solution. Authoritarian strategies, such as Grint (2010) points out, could possibly work the best for simple Type 1 problems. These cases involve fewer parties or people involved in the comparison of wicked problems, where members still have conflicting interests or values. Collaborative methods seem to gain more and more relevance in the scale of Type 3 problems, because when there are more stakeholders and their visions are not commonly shared, the collaboration will become more relevant (Grint 2010; Hellard and Melles 2011; Blyth and Kimbell 2011).

Interestingly, according to Table 4, all the tools require a collaborative strategy. In a way, it seems to revalidate Robert's (2000) idea that wicked problems require a collaborative approach, and that the competitive approach could be unproductive. All of these tools were probably created with a purpose of enabling collaborative stakeholder work. As the stakeholders, participants are joined together to tackle a wicked problem. They need to work first together by defining what the problem is, although participants tend to have conflicting opinions or interests. As Rittel and Webber (1973) have written, how the wicked problem is defined will influence how the problem is resolved. This way, having a collaborative approach for all is a way to start to involve stakeholders.

Something that many of these tools have in common is how to visualize the problem in the form of a map. Designers play an important role in this, because they are accustomed to visualize the problems (Blyth and Kimbell 2011). Problem visualization helps all process participants to better understand what they are experiencing. A scale of one to five is used to show the need of a designer to illustrate during the process. One is when it is not that needed and five when it is the most needed. As Table 4 shows, it is evident that the Mess MapTM and Resolution MapTM need more support from the designers, to visualize the maps created manually or on the computer. There are already several online versions to make these types of maps with digital tools that can be adapted for several purposes, such as Deon, Mural, and Realtime Board. The use of software has even increased the need for visual thinking and visualization (Sevaldson 2001).

For General Morphological Analysis, grade 3 is chosen because it can be performed without a graphic designer. This tool could be improved through graphical visualization so that the graphics would be more ergonomic and easier to be understood. In the process of General Morphological Analysis, it would be recommended to have a designer in the ideation phase of the axes. The Dialogue Map gained 4 as a grade, because it can be done without a visual designer and the program will do the work of creating the map. Yet a designer could make the dialogue more understandable by putting images and colors in the presentation, which apparently has not yet been used to its fullest. You can make a Dialogue Map by hand, but its execution would be more difficult than with a program.

The four tools can also be classified in the form of their goals and if they are assigned to understand a WP or try to resolve it. Mess MapTM is a tool for diagnosing a WP and is commonly used in conjunction with a Resolution MapTM to create resolutions. Dialogue Mapping also performs a survey of a WP in question, but the General Morphological Analysis is the one that fits into many situations. It can be used to understand a WP but also to create possible scenarios and analyses of them. The Mess MapTM, in comparison to Dialogue Mapping, seems to be more complete as it also somehow maps the dialogue when done in a group, but it is not delimited only to it. Mess MapsTM can also use other valid information that the team can find from searches performed in journals and newspapers as an example.

There is an urgent need for collaborative work as Table 4 illustrates. Designers are used to working collaboratively, so this type of background gives them the skills in mediating wicked problem projects. This is one of the reasons why designers could and should position themselves as mediators of the process. These tools often have the aim of provoking change that is wicked. Interestingly Sangiorgi (2011, 1) points out that “service design is entering the fields of organisational studies and social change with little background knowledge of their respective theories and principles.” I agree that in this scope designers should learn more about organizational studies skills and management in order to better fill their role as mediators of these tools (Schanz and De Lille 2017).

Conclusion

The terminology or concept of a WP is not new, as the subject was first discussed in the seventies by two Berkeley university professors. In the 1990s, Buchanan (1992) wrote another landmark article emphasizing that there are wicked problems in Design Thinking. In order to deal with these types of problems, we need multidisciplinary teams and collaboration between various parties. Designers have the training to work and to mediate in these types of environments. Designers should be aware that when they receive a design brief, they need to define the category to which the problem belongs and to indicate what strategy and what tools are appropriate for its solution or resolution. It should be kept in mind that tools designed for simple problems do not work or can even make the process more difficult for wicked problems.

As the literature review showed, the greater the difficulty or complexity of the problem, the more collaboration the participants need to use. The role of the designers is important as a visualizer of the ideas of the group, generating resolutions. Designers should also have the skills

for listening and showing empathy while developing an understanding of the problem. Not all participants are able to take on the role of visualizer or mediator of the process. It is worth noting that in using the tools discussed in this article, it would be useful to have designers on board who could facilitate the participants' visual comprehension. The same is true for the case of morphological analysis; having a graphic designer working with the team, for example, could make the matrix visually more enjoyable and clearer to read, with colors and related images. Future studies are recommended to facilitate the understanding of the visual form of these tools. Note that Mess MapsTM are especially complex and designers could help in clarifying such visual aids.

Designers are seen as visualizers of problems, but in my opinion, they should also be like mediators and facilitators of the process, as many work with sociotechnical systems in various design fields. Sociotechnical systems seem to be wicked, as they work, for example, with the complexities that stakeholders bring to a problem. Visualization will help in understanding wickedness and how to start treating it, by making scenarios. Designers are also able to listen and create empathy towards the problem at hand. It would be interesting to see how this could be adapted in the use of these tools too. As cited before, designers will need more background knowledge of management and organizational change in order to better perform the task of mediating the solutions to wicked problems. I recommend more future studies in this as well. Designers can, in my opinion, take a managerial role as they are used to using collaborative tools in their practice. Facilitating the process is already one type of managerial position that departs from a horizontal position or bottom-up approach.

I also recommend future studies on methods such as Design Thinking, Double Diamond, and The Soft Systems Method. Designers could benefit from these methods in wicked problems. There could also be an interesting connection of using uncertainty and robustness as concepts together with the wicked problem theory. What might be the result of incorporating such approaches? What would be the connection between the designer's visualization capacity and their empathic skills? Another issue to examine further is the collaboration and holistic perspective in WPs. Treating WPs requires the participation of different stakeholders. As different people from various backgrounds need to collaborate, a holistic perspective is necessary. Also, deeper inquiries could be made about the tools cited in this article, as graphic design could improve the ergonomics of these tools. It should be noted that not all of the examples in this article necessarily had the participation of a designer in their application. This can be readily seen in the case of General Morphological Analysis. For this reason, I also recommend more future studies in this field. As the literature review has shown, it is important to recognize the role of designers as tamers, mediators or facilitators, and visualizers of contemporary problems.

Acknowledgements

I would like to show my gratitude to the Lapland Regional Fund of the Finnish Cultural Foundation for their one-year grant for my PhD research.

This article was translated and adapted, updated, and refocused from an article published in *Educação Gráfica* (Suoheimo 2016) and has the journal's authorization for translating and republishing it in English.

REFERENCES

- Avdiji, Hazbi, Dina Elikan, Stéphanie Missonier, and Yves Pigneur. 2018. "Designing Tools for Collectively Solving Ill-Structured Problems." In *Proceedings of 51st Hawaii International Conference on System Sciences*, Hawaii, January 3-6, 400–09, 2018.
- Blyth, Simon, and Lucy Kimbell. 2011. *Design Thinking and the Big Society: From Solving Personal Troubles to Designing Social Problems*. London: Actant and Taylor Haig.

- Brown, Tim. 2008. "Design Thinking." *Harvard Business Review* 86 (6): 75–84.
- Brown, Tim, and Jocelyn Wyatt. 2010. "Design Thinking For Social Innovation." *Development Outreach* 12 (1): 29–43.
- Buchanan, Richard. 1992. "Wicked Problems in Design Thinking." *Design Issues* 8 (2): 5–21.
- Camillus, John C. 2008. "Strategy as a Wicked Problem." *Harvard Business Review* 86 (5): 89–98.
- Conklin, Jeff. 2006. "Dialogue Mapping." *Building Shared Understanding of Wicked Problems*. West Sussex, England: John Wiley & Sons.
- Doz, Yves L., and Gary Hamel. 1998. *Alliance Advantage: The Art of Creating Value through Partnering*. Boston: Harvard Business Press.
- Dumont, Jeffrey P., Flynn J. Heiss, Kevin C. Jones, Clifford A. Reiter, and Lisa M. Vislocky. 2001. "n-Dimensional Chaotic Attractors with Crystallographic Symmetry." *Chaos, Solitons & Fractals* 12 (4): 761–84.
- Eriksson, Tomas, and Tom Ritchey. 2002. "Scenario Development Using Computerised Morphological Analysis." Adapted from a Paper Presented at the Winchester International OR Conference, England, 2002. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.9096&rep=rep1&type=pdf>.
- Grint, Keith. 2010. "Wicked Problems and Clumsy Solutions: The Role of Leadership." In *The New Public Leadership Challenge*, edited by Stephen Brookers and Keith Grint, 1–15. London: Palgrave Macmillian.
- Head, Brian W. 2008. "Wicked Problems in Public Policy." *Public Policy* 3 (2): 101.
- Head, Brian, and John Alford. 2008. "Wicked Problems: Implications for Policy and Management." In *Presentation delivered to the Australasian Political Studies Association Conference*, 6–9.
- . 2013. "Wicked Problems: Implications for Policy and Management." *Administration & Society* 47 (6): 1. <https://doi.org/10.1177/0095399713481601>.
- Heifetz, Ronald A. 1994. *Leadership without Easy Answers*, vol. 465. Cambridge, MA: Harvard University Press.
- Howard, Zaana, and Gavin Melles. 2011. "Beyond Designing: Roles of the Designer in Complex Design Projects." In *Proceedings of the 23rd Australian Computer-Human Interaction Conference*, 152–55. Canberra: ACM.
- Horn, Robert E., and Robert P. Weber. 2007. *New Tools for Resolving Wicked Problems: Mess Mapping and Resolution Mapping Processes*. Strategy Kinetics LLC. https://www.strategykinetics.com/New_Tools_For_Resolving_Wicked_Problems.pdf.
- Irwin, Terry, Gideon Kossoff, and Cameron Tonkinwise. 2015. "Transition Design Provocation." *Design Philosophy Papers* 13 (1): 3–11.
- Jones, Peter H. 2014. "Systemic Design Principles for Complex Social Systems." In *Social Systems and Design*, edited by Gary Metcalf, 91–128. Springer, Tokyo.
- Jones, Peter H., and G. K. Van Patter. 2009. "Design 1.0, 2.0, 3.0, 4.0: The Rise of Visual Sensemaking." *NextD Journal Special Issue* (March 2009): 1–12.
- Kimmel, Shari J., Howard S. Kimmel, and Fadi P. Deek. 2003. "The Common Skills of Problem Solving: from Program Development to Engineering Design." *International Journal of Engineering Education* 19 (6): 810–17.
- Kunz, Werner, and Horst W. J. Rittel. 1970. *Issues as Elements of Information Systems*, vol. 131. Berkeley, CA: Institute of Urban and Regional Development, University of California.
- Koppenjan, Johannes Franciscus Maria, and Erik-Hans Klijn. 2004. *Managing Uncertainties in Networks: A Network Approach to Problem Solving and Decision Making*, vol. 40. London: Routledge.
- Meroni, Anna. 2008. "Strategic Design: Where Are We Now? Reflection around the Foundations of a Recent Discipline." *Strategic Design Research Journal* 1 (1): 31–8.

- Munneke, Lisette, Jerry Andriessen, Gellof Kanselaar, and Paul Kirschner. 2007. "Supporting Interactive Argumentation: Influence of Representational Tools on Discussing a Wicked Problem." *Computers in Human Behavior* 23 (3): 1072–88.
- Norman, Donald A., and Pieter Jan Stappers. 2015. "DesignX: Complex Sociotechnical Systems." *She Ji: The Journal of Design, Economics, and Innovation* 1 (2): 83–106.
- Péli, Gábor, and Jeroen Bruggeman. 2006. "Networks Embedded in N-Dimensional Space: The Impact of Dimensionality Change." *Social Networks* 28 (4): 449–53.
- Pfeffer, Jeffrey. 1992. *Managing with Power: Politics and Influence in Organizations*. Boston: Harvard Business Press.
- Ritchey, Tom. 2006. "Problem Structuring Using Computer-aided Morphological Analysis." *Journal of the Operational Research Society* 57 (7): 792–801.
- . 2013. "Wicked Problems: Modelling Social Messes with Morphological Analysis." *Acta Morphologica Generalis* 2 (1): 1–8.
- Rittel, Horst W. J., and Melvin M. Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4 (2): 155–69.
- Roberts, Nancy. 2000. "Wicked Problems and Network Approaches to Resolution." *International Public Management Review* 1 (1): 1–19.
- Sangiorgi, Daniela. 2009. "Building a Framework for Service Design Research." In *Proceedings of the 8th European Academy of Design Conference*, 415–20. Aberdeen, Scotland.
- . 2011. "Transformative Services and Transformation Design." *International Journal of Design* 5 (2): 29–40.
- Scariot, Cristiele A., Adriano Heemann, and Stephania Padovani. 2012. "Understanding the Collaborative-Participatory Design." *Work* 41 (Supplement 1): 2701–05.
- Schanz, Jonathan, and Christine De Lille. 2017. "Customer Experience Strategy Tuned into Hands-On Actions Through a Design Approach." *Design Management Journal* 12 (1): 28–39.
- Sevaldson, Birger. 2001. "The Renaissance of Visual Thinking." In *Konference om Arkitekturforskning og IT*, Nordic Association for Architectural Research Aarhus, Denmark. <http://www.birger-sevaldson.no/phd/The%20renaissance%20of%20visual%20thinking.pdf>.
- Seybold, Patricia. B. 2013. "'Netting It Out', review of How to Address 'Wicked Problems': Use Dialogue Mapping to Build a Shared Understanding and Evolve a Group's Thinking, by Patricia Seybold Group." http://www.customers.com/media/docs/articles/Using-Dialogue_Mapping-to-Address-Wicked-Problems-05-23-2013.pdf.
- Suoheimo, Mari. 2016. "Estratégias e ferramentas visuais para solução de problemas wicked." *Educação Gráfica* 20 (2): 96–114.
- Suoheimo, Mari, and Satu Miettinen. 2018. "Complexity Mapping and Mess Mapping Tools for Decision-Making in Transportation and Maas Development." In *Academic Design Management Conference: Next Wave*, August 1–2, 2018. London: DMI.
- Van Bruggen, Jan M.; Henny P. A. Boshuizen, and Paul A. Kirschner. 2003. "A Cognitive Framework for Cooperative Problem Solving with Argument Visualization." In *Visualizing Argumentation*, edited by Paul A. Kirschner, Simon J. Buckingham-Shum, and Chad S. Carr, 25–47. London: Springer.
- Williams, Thomas, Lennart Johns, and Chris Hakala. 2017. "Issue Mapping and Inquiry: Preparing College Students for the Challenges of the Changing Economic World." *Psychology and Behavioral Science International Journal* 4 (3): 1–6.

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