The Generator project as a paradigm for systemic design

Ben Sweeting
University of Brighton

Abstract

In systemic design, agreements over how to resolve wicked problems may be quickly outdated by changing circumstances and unforeseen consequences. One approach is thus to design systems that can adapt or be adapted to the circumstances they find themselves in. Adaptability may, however, act conservatively, making outdated resolutions more resilient and so harder to change. In order to explore adaptability further, this paper introduces a precedent from the discipline of architecture: Generator – an unbuilt proposal for a retreat centre designed by Cedric Price during the late 1970s. Strongly influenced by the work of cybernetician Gordon Pask via consultants Julia and John Frazer, not only could Generator be reconfigured by its human participants to support different activities, it also had the capacity to rearrange itself should it be left in the same configuration for too long. Interpreting the project in terms of the role of difference in Pask's conversation theory, this paper explores Generator as a possible paradigm for systemic design in situations where a stable consensus for action is either unfeasible or undesirable.

Introduction

> Architecture is too slow in its realisation to be a 'problem solver'. Thus C.P. Office sees its particular product (buildings) as the readily recognisable parts of its continuous design process. (Price, 2003, p. 136)

When working in systemic contexts, designers must address what Horst Rittel and Melvin Webber (1973) called "wicked problems"—situations where complex interdependencies and uncertain boundaries mean that conventional linear forms of problem solving are inapplicable. As wicked problems have no incontestable right answer, their resolution is, ideally, through forming a consensus amongst those involved. However, even where consensus is possible it must be regarded as temporary: The incomplete and changeable character of wicked problem situations means that any proposed response may be quickly superseded. Rittel and Webber (1973) emphasise this point by using the term "resolution" to indicate the need "re-solve" wicked problems again and again (p. 160). This is especially the case in systemic design practice, as designers move beyond their traditional realms of products and services to address complex multi-stakeholder domains (Jones, 2014; Jones & Kijima, 2018; Ryan, 2014).

One strategy for addressing such a situation is for designers to give what they design the ability to adapt or be adapted to future changes in circumstance. The ability to respond to a changing context is important for both stability and change. Consider, for instance, the cybernetic metaphor of steering a ship, where the ability to maintain a steady course allows not just for a heading to be followed but also for it to be (intentionally) changed (Sweeting, 2015). Thus, in different contexts, adaptability can be thought of variously in terms of resilience, flexibility, incremental improvement, optimisation,

organisational learning, and, most ambitiously, as the design of systems that continue to design themselves.

At first sight, then, adaptability seems to be a clearly beneficial attribute when it comes to addressing wicked problems. However, as is often the case in systemic contexts, this depends very much on which perspective the situation is considered from. As every wicked problem tends to be a symptom of another (Rittel & Webber, 1973, p. 165), incrementalism risks treating the symptoms rather than the cause and, in so doing, may make the broader situation more resistant to change. Adaptation to maintain a system in a changing environment is all well and good so long as the resolution to the wicked problem that led to *that* system's design remains valid. However, if the consensus over the previous resolution no longer holds, adaptation can make more radical changes harder to achieve. Resilience, for instance, can be criticised for entrenching the status quo along with its various inequalities (Derickson, 2016). Incremental adaptability, as Luke Feast (2020) has argued in the context of unwritten constitutions, may also hamper responses to issues where long term commitments are required, such as the climate crisis. Depending how it is done, even giving systems the ability to design themselves may build in path dependency or embed simplistic design rationales such as optimisation. Thus, while adaptability will always be an important consideration in responding to wicked problems, it needs to be treated as a further design challenge rather than a design response in itself.

In order to explore some of the issues surrounding adaptability, this paper introduces a precedent study from the work of British architect Cedric Price: Generator, an unbuilt project designed during the second half of the 1970s, with Julia and John Frazer acting as consultants (see e.g. Furtado Cardoso Lopes, 2008; Hardingham, 2016; Price, 1984, pp. 92-97; Spiller, 2002, pp. 84-89; Steenson, 2010; 2017, pp. 147-163). The project is one of Price's most radical attempts to extend the design process into the life of a building, and a prominent precedent for approaches to interactive architecture in terms of "conversational customisation" (Stralen, 2017). In this paper, I interpret the project in terms of what Hugh Dubberly and Paul Pangaro (2019) have called "design-*for*-conversation" or "second-order design" and, in so doing, position it as significant for the broader context of systemic design.

The built environment is one of the most challenging contexts in which to design for adaptability and focusing on it can give tangible examples of many of the systemic difficulties involved. As well as the physical difficulty of making any changes, there is also the way that those affected by the built environment often have little agency over it. For example, even if we had the tools, time, and skill to move this wall, we don't have permission to do so. This is a matter of ownership or management and also, often, of regulatory approval and professional expertise. Even where the possibility of moving a wall has been designed-in through moveable partitions, there are still questions of consensus. The room where this presentation was given was overcrowded, without enough space for everyone to sit. If the walls were movable partitions, we might increase the seating capacity of the room but how would we negotiate this with the users of the room next door who might have similar needs? And even if they don't need the space at this moment, is it worth the time and effort to rearrange the room when we could just make do as things are? It is often easier to adapt ourselves to spaces rather than adapt them to us. While these issues seem specifically architectural, similar challenges of asymmetrical agency, inertia, and boundary conflict are features of wicked problems in a broad range of contexts. By focusing on Generator's distinctive strategies for addressing these, this paper explores its potential as a systemic design paradigm beyond the context of the built environment.

Generator

Generator was designed for the Gilman paper company as a retreat centre. Located in the company's White Oak Plantation on the border of Florida and Georgia, the project consisted of various enclosures, walkways and screens. It had no fixed form and could be set out in various ways to support different activities. Decisions about how to configure the building were made by the visitors to the complex using a computer interface. The computer would then draw up new plans, taking into account the structural qualities of the components (Steenson, 2017, p. 156), and the building could then be rearranged accordingly with the use of a mobile crane. Though unconventional, this was not a paper project. While it remained unbuilt, this was due to a lack of support for the project amid uncertainty within the company rather than the design being unfeasible in itself (Steenson, 2017, p. 161).

The reconfigurable components reduce the physical inertia that is typical of the built environment, while the computer programme means that further professional expertise is not needed. Generator's ability to be physically reconfigured, as radical as this was and is, only goes so far, however. That we can rearrange our physical environment does not mean that we will. Rather than suggest new arrangements, we might still opt for activities that fit with the existing layout as this is what is immediately to hand: It requires less effort, consensus amongst participants will be easier to achieve, and our initial encounters with the existing environment will suggest proposals for activities to us (if the retreat centre is set up to play piano, this will suggest this activity to us as something to do).

Central to Generator's design is how to support and maintain the dynamism of the project. The design included two human roles—known as "Factor" and "Polariser". Factor, who was to enact proposals and address other operational aspects, provided the time, effort, and know-how required to reconfigure the layout. Polariser was to support visitors in their interactions with each other and with the unfamiliar environment of Generator, prompting new activities and configurations. The roles of Factor and Polariser were complemented by the most striking feature of Generator, the capacity of its computer program to become bored: If visitors did not reconfigure the layout for new activities, Generator would start generating its own unsolicited plans, which Factor would then enact. As the Frazers wrote to Price: "If you kick a system, the very least that you would expect it to do is kick you back" (quoted in Steenson, 2017, p. 156).

The significance of the boredom program is twofold. Firstly, the configurations proposed by visitors, even with Polariser's encouragement, would inevitably be limited by what could be imagined and desired in advance. That is, the need to make a plan may lead to a tendency to select between known possibilities. Generator's boredom program creates a deeper sense of novelty, confronting participants with possibilities that they hadn't thought of or which they might have been less comfortable suggesting. In this sense, Generator is genuinely interactive rather than just reactive: not only does the architecture respond to the demands of its inhabitants, it also makes demands on them by presenting new constraints and opportunities.

Secondly, the boredom program requires visitors to actively use their agency over their environment. In conventional terms, a configuration would be regarded as successful if it is not changed by its users as this would indicate it meets present needs. To change a stable configuration is therefore effectively to make Generator *less suitable for its current use*. By breaking the status quo, Generator not only opens up new possibilities, it also puts its current use in question and reminds visitors of their ability to make changes. Notice how visitors could easily choose to reinstate a particular configuration that Generator had become bored with, but that they must actively choose to do this rather than it continuing by

default. This is a very different approach to contemporary paradigms where so-called smart technologies adapt themselves to suit how we use them and, in so doing, conservatively reinforce our present patterns of activity (regarding smart technology, see Fantini van Ditmar, 2016, 2019).

Conversation and difference

Generator has tended to be discussed primarily in terms of technology and the development of artificial intelligence in the context of the built environment (e.g. Landau, 1985; Sudjic, 1981). While Generator's technological achievements are considerable, the significance of the project is not its technology per se but the particular interactive structure that this supports. To understand this in more depth, it is helpful to see the project in the light of one of its key influences, British cybernetician Gordon Pask.

Pask had become involved in architecture, art, and design in various ways during the 1960s, including working with Price and theatre director Joan Littlewood on the unbuilt but highly influential Fun Palace project. Conceived as a "university of the streets" (Littlewood, 1964, p. 432) that would combine leisure and education in new ways, the Fun Palace was more ambitious in scale and program than Generator but had a similar ethos, with architectural components being continually reconfigured to support different activities. Pask's contribution focused on the dynamics of the project and in particular the issue that would become central to Generator: how to maintain a continually novel environment.

The Frazers knew Pask from the Architectural Association, where he held a position as a consultant. The boredom program was inspired by Pask, who had developed the idea as part of his 1950s Musicolour installation (Furtado Cardoso Lopes, 2008, Note 27; Pask, 1971). The Frazers' characterisation of the project as "kicking back" also echoes Pask. As Ranulph Glanville (2009) reports, Pask would use the example of kicking a chair to summarise the circularity of even seemingly linear actions: "You kick it [a chair]. It does not necessarily—or normally—kick back. But your foot may well hurt. Thus, in the most linearly directional of actions there is the potential for circularity of response (i.e., interaction). Having hurt your foot you may choose not to kick a chair again…" (p. 67).

The centrepiece of Pask's cybernetics was his (1976) conversation theory, published the same year as the Generator project began. Conversation theory accounts for how, given the premise that ideas cannot be passed directly from one participant in a conversation to another, it is still possible for participants to coordinate their understanding and agree on shared meanings. Consider, for instance, an everyday verbal conversation between two people where one is trying to share an idea with the other. The first participant presents their understanding. This cannot be passed directly to the second participant, so they construct their own idea of what the first person is trying to say and present this (their understanding of the other's idea) back to the first participant. Again, the first participant cannot receive this understanding directly, so they construct their own understanding of this. That is, they construct their own understanding of what the other has understood of what they initially presented. By comparing this with the original idea they were trying to communicate, they get a sense of to what degree the other understands them. Notice how each participant only needs access to the ideas they have constructed themselves in order to do this, the whole structure having the recursive form "what I think of what you think I think, etc." (Glanville, 1993).

This circularity can be used both to coordinate agreement and also as a way to generate new ideas. If a participant in a conversation finds that there is a large difference between what they are trying to communicate and what they understand the other to have understood of this, they can try to clarify by explaining further or in a new way. The process can continue until participants reach agreement, which

could be the agreement to disagree (Pask, 1988, p. 85). Note, though, how what is meant here by agreement is not that each participant has the same understanding but that they coordinate their separately constructed ideas in relation to each other. The difference between participants' meanings is maintained even in agreement and this drives the conversation forward in new ways: Participants see different things in what they hear than were intended and learn about what is implied in what they have said through how others understand it.

Pask's understanding of conversation is very different to where communication is approached in terms of the passing and receiving of messages. As Pask (1980) notes, while some communication (in the sense of message transmission) is necessary to sustain a conversation, "very bad communication may admit very good conversation and the existence of a perfect channel is no guarantee that any conversation will take place" (p. 999). While in earlier projects Pask had looked to increase communication channels to amplify feedback processes, by the 1980s he was concerned that the by then rich information environment was eroding the possibility for conversation by eliminating difference. Whereas conversation requires and generates difference, the transmission of messages aims to equate what is understood to what is meant. Communication as message transmission is thus conservative, in that it aims to minimise new understanding from arising. It can also be violent, in that the listener's meaning is to be reduced to that of the speaker's intention (on this point see Herbert Brun's anticommunication as summarised by e.g. Lombardi, 2020).

Understanding Generator in terms of conversation theory, the role of the boredom program is to sustain or restart the conversations of its human participants by introducing and maintaining difference. With the encouragement of Polariser, visitors would converse with each other over which activities to pursue and how to reconfigure the architecture to suit. Sometimes these conversations would not generate changes in the layout. This may be because of a lasting consensus within the group as to which activities to pursue, or perhaps the conversation has stalled through a lack of ideas, the dominance of one participant, or some other impasse. By introducing its own unsolicited ideas, the boredom program introduces new (i.e. different) possibilities to respond to. Whether or not these are an improvement in the eyes of the participants, they serve to put the status quo in question, restarting the conversation. Even if participants want to return Generator to the status quo ante, they now need further conversation to reaffirm the previous consensus.

Generator as design conversation

Generator's boredom program can be understood in terms of design activity in at least two ways. Firstly, there is its (the computer's) ability to draw up its own proposals and, as Landau (1985, p. 7) stresses, its potential to learn from experience in how it does this. Secondly, these proposals may be understood as sustaining and contributing to a wider design conversation together with Generator's human participants. It is the second of these that is, I suggest, the most significant.

Although reaching agreement for action is central to designing, doing so too quickly may leave underlying assumptions unquestioned. Keeping design conversations alive is particularly important in the context of wicked problems, where there is no once and for all solution to be found. Generator's boredom program resembles various ways to sustain design conversations by introducing or heightening difference. Examples include designers' use of play, humour, and tension (Perera, 2020; Ryan et al., 2016); sampling for requisite variety in stakeholder selection (Jones, 2018); and the value that can be found in unmanageability as a process of enrichment (Fischer, 2019; Glanville, 1997). It is also possible to think of the characteristic design activity of sketching in similar terms. In understanding sketching

through Pask's conversation theory, Glanville (2007, 2014) stresses the difference between drawing (speaking) and looking (listening) that is enabled through the use of media. Conventionally, the difference between what is understood and what was meant is characterised as a gap to be closed through iteration. Alternatively, one can understand this difference as what keeps the conversation moving, thus reframing error in positive terms as presenting opportunities. It follows that a sketch turning out exactly as it was planned can be a weakness rather than a strength. If there is no difference between what is drawn (said) and seen (heard), nothing is learnt: the conversation has stalled and is now merely communication in the sense of message transmission. This might be appropriate when producing final drawings for presentation or production information, but it is of limited use in creating new insight as it is effectively telling the designer what they already know. For this reason, designers often sketch in ways that encourage ambiguity, thus allowing for multiple interpretations (Price's sketches for Generator being a case in point).

Thinking of Generator in terms of design conversation, the project may also help us think about other discourses that have been understood in terms of design, such as scientific research and ethics (Glanville, 1999; Sweeting, 2017, 2018). Both science and ethics can tend to be thought of as presenting us with incontestable ideas – objective facts and moral codes. Yet, on closer inspection, contestation and difference are crucial in both cases in guarding against scientism and moralisation. In the context of science, see for instance: Glanville (2001) on the role of the difference between experience and description; and Paul K. Feyerabend's (1978, 1975/1993) arguments for methodological pluralism. In the context of ethics, see for instance my work understanding ethical dilemmas in terms of wicked problems and implicit ethical questioning (Sweeting, 2018).

Implications for systemic design

By maintaining difference even in agreement, Generator goes beyond conventional forms of adaptability, extending design as conversation into the ongoing experience of what is designed (c.f. Dubberly & Pangaro, 2019). The boredom program challenges consensus, putting current use in question. While this is disruptive, the flexibility of the environment also allows for a quick return to the preceding configuration if a new conversation reaffirms previous agreements. This has the effect of maintaining difference (and so conversation) even in agreement, with consensus needing to be dynamically maintained.

As well as its status as paradigm for interactive architecture, Generator's way of sustaining and reopening conversation has value in the broader context of systemic design. In systemically complex domains, agreement amongst multiple stakeholders might be unfeasible due to incommensurable values and goals, while even the most robust of consensuses might quickly become outdated through changing circumstances and unforeseen consequences. Moreover, consensus could even be undesirable as a design objective, such as where the imposition of an artificial or one-sided solution obstructs necessary debate or risks the imposition of designers' values onto others. In the relatively well-defined context of, say, an organisation or a service, it will often be possible to reach a resolution that may last some time before it needs to be re-solved again. In the most complex contexts, however, resolutions will require ongoing conversation in order to avoid previous consensuses becoming part of present problems. By continually unpicking consensus while simultaneously allowing it to be remade, Generator offers a template for designing for conversation in contexts where agreement is not in itself enough.

Conclusion

In addressing wicked problems, it is desirable to form consensuses amongst stakeholders over how to act. In the context of systemic design, however, a stable consensus may be unfeasible or even undesirable. Faced with the need to re-solve wicked problems again and again, one response is to design systems with the ability to adapt or be adapted to changing circumstances. While adaptability may help a system become more resilient, conservative feedback loops and incremental improvements may also hinder more radical change where this is subsequently needed.

This paper has explored a possible strategy for adaptability by discussing the Generator project as a precedent. Generator is well known in the context of interactive architecture, where its ability to reconfigure itself distinguishes it from conventional reactive environments. Understanding Generator in terms of Pask's conversation theory, I have interpreted the boredom program as a way of sustaining and restarting conversation through the continual re-introduction of difference. Reading the project in this way expands the relevance of the boredom program. In addition to Generator's intention to encourage and prompt new activities, the boredom program can also be understood as a way of maintaining conversation beyond agreement. By continually putting its current use in question, Generator requires any consensus to be continually reaffirmed if it is to continue. Generator's strategy may inform systemic design in other contexts. Sustaining design conversation beyond the initial agreement on how to act is one way to prevent adaptability sustaining outdated resolutions.

References

Derickson, K. D. (2016). Resilience is not enough. *City, 20*(1), 161-166. https://doi.org/10.1080/13604813.2015.1125713

Dubberly, H., & Pangaro, P. (2019). Cybernetics and design: Conversations for action. In T. Fischer & C. M. Herr (Eds.), *Design cybernetics: Navigating the new* (pp. 85-99). Springer International Publishing. https://doi.org/10.1007/978-3-030-18557-2_4

Fantini van Ditmar, D. (2016). *IdIOT: Second-order cybernetics in the 'smart' home* [Doctoral dissertation, Royal College of Art]. British Library. https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.690638

Fantini van Ditmar, D. (2019). A circular 'smart' world. In T. Fischer & C. M. Herr (Eds.), *Design cybernetics: Navigating the new* (pp. 101-117). Springer International Publishing. https://doi.org/10.1007/978-3-030-18557-2_5

Feast, L. (2020). In proportion: Analysing New Zealand's constitutional system. *FormAkademisk - Research Journal of Design and Design Education, 13*(2). https://doi.org/10.7577/formakademisk.3367

Feyerabend, P. K. (1978). *Science in a free society*. NLB.

Feyerabend, P. K. (1993). *Against method* (3rd ed.). Verso. (Original work published 1975)

Fischer, T. (2019). Transcomputability, (Glanville's corollary of) Ashby's law of requisite variety and epistemic processes. *Kybernetes, 48*(4), 793-804. https://doi.org/10.1108/K-11-2017-0457

Furtado Cardoso Lopes, G. M. (2008). Cedric Price's Generator and the Frazers' systems research. *Technoetic Arts, 6*(1), 55-72. https://doi.org/10.1386/tear.6.1.55_1

Glanville, R. (1993). Pask: A slight primer. *Systems Research, 10*(3), 213-218. https://doi.org/10.1002/sres.3850100326

Glanville, R. (1997). The value of being unmanageable: Variety and creativity in cyberspace. In H. Eichmann, J. Hochgerner, & F. Nahrada (Eds.), *"Netzwerke", proceedings of global village '97 conference*. Falter Verlag.

Glanville, R. (1999). Researching design and designing research. *Design Issues, 15*(2), 80-91. https://doi.org/10.2307/1511844

Glanville, R. (2001). An observing science. *Foundations of Science, 6*(1), 45-75. https://doi.org/10.1023/a:1011353225749

Glanville, R. (2007). Try again. Fail again. Fail better: The cybernetics in design and the design in cybernetics. *Kybernetes, 36*(9/10), 1173-1206. https://doi.org/10.1108/03684920710827238

Glanville, R. (2009). *The black b∞x: Vol. 3. 39 steps*. Edition Echoraum.

Glanville, R. (2014, October 15-17). *How design and cybernetics reflect each other* [Keynote presentation]. Relating Systems Thinking and Design (RSD3) 2014 Symposium, Oslo, Norway. http://systemic-design.net/rsd3-proceedings/rsd3-keynote-abstracts/

Hardingham, S. (Ed.). (2016). *Cedric Price works 1952-2003: A forward-minded retrospective*. Architectural Association.

Jones, P. (2018, October 24-26). *Evolutionary stakeholder discovery: Requisite system sampling for co-creation* [Paper presentation]. Relating Systems Thinking and Design (RSD7) 2018 Symposium, Torino, Italy. http://openresearch.ocadu.ca/id/eprint/2743/

Jones, P. H. (2014). Systemic design principles for complex social systems. In G. Metcalf (Ed.), *Social systems and design* (pp. 91-128). Springer. https://doi.org/10.1007/978-4-431-54478-4_4

Jones, P. H., & Kijima, K. (Eds.). (2018). *Systemic design: Theory, methods, and practice*. Springer. https://doi.org/10.1007/978-4-431-55639-8.

Landau, R. (1985). A philosophy of enabling: The work of Cedric Price. *AA Files*(8), 3-7. www.jstor.org/stable/29543432

Littlewood, J. (1964). A laboratory of fun. *New Scientist, 22*(391), 432-433.

Lombardi, J. (2020). Traces left by Herbert Brün that orient my cybernetics (Maybe). *Kybernetes*, . Advance online publication. https://doi.org/https://doi.org/10.1108/K-04-2019-0270

Pask, G. (1971). A comment, a case history and a plan. In J. Reichardt (Ed.), *Cybernetics, art and ideas* (pp. 76-99). Studio Vista.

Pask, G. (1976). *Conversation theory: Applications in education and epistemology*. Elsevier.

Pask, G. (1980). The limits of togetherness. In S. H. Lavington (Ed.), *Information processing* (pp. 999-1012). North Holland Publishing Company.

Pask, G. (1988). Learning strategies, teaching strategies, and conceptual or learning style. In R. R. Schmeck (Ed.), *Learning strategies and learning styles* (pp. 83-100). Plenum Press.

Perera, D. (2020). Wicked problems, wicked play: Fun machines as strategy. *FormAkademisk - Research Journal of Design and Design Education, 13*(2). https://doi.org/10.7577/formakademisk.3378

Price, C. (1984). *The square book*. Wiley.

Price, C. (2003). *Re: CP* (H. U. Obrist, Ed.). Birkhäuser.

Rittel, H., & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*, 155-169.

Ryan, A. (2014). A framework for systemic design. *FormAkademisk - Research Journal of Design and Design Education, 7*(4). https://doi.org/10.7577/formakademisk.787

Ryan, A., Baumgardt, A., & Pangaro, P. (2016, October 13-15). *Playing with fire: Designing with and for tension in groups* [Panel discussion]. Relating Systems Thinking and Design (RSD5) 2016 Symposium, Toronto, ON, Canada. https://systemic-design.net/rsd-symposia/rsd5-2016/process-innovation/

Spiller, N. (Ed.). (2002). *Cyber_reader: Critical writings for the digital era*. Phaidon Press.

Steenson, M. W. (2010). Cedric Price's Generator. *Crit (the journal of the American Institute of Architecture Students), 69*. http://www.girlwonder.com/blog/wp-content/uploads/2010/04/crit-piece.pdf

Steenson, M. W. (2017). *Architectural intelligence: How designers and architects created the digital landscape*. MIT Press.

Stralen, M. van. (2017). *Dynamic architectural systems: Parametric design and digital fabrication towards conversational customization* [Doctoral thesis, Federal University of Minas Gerais]. https://repositorio.ufmg.br/handle/1843/MMMD-B4RHUJ

Sudjic, D. (1981). Birth of the intelligent building. *Design,* (385), 56.

Sweeting, B. (2015). Cybernetics of practice. *Kybernetes, 44*(8/9), 1397-1405. https://doi.org/10.1108/K-11-2014-0239

Sweeting, B. (2017). Design research as a variety of second-order cybernetic practice. In *New horizons for second-order cybernetics* (pp. 227-238). World Scientific. https://doi.org/10.1142/9789813226265_0035

Sweeting, B. (2018). Wicked problems in design and ethics. In P. H. Jones & K. Kijima (Eds.), *Systemic design: Theory, methods, and practice* (pp. 119-143). Springer Japan. https://doi.org/10.1007/978-4-431-55639-8