Open-ended Design as Second-order Design. A case study of teaching Cybernetics and System Thinking to Industrial Design students.

Working Paper

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Introduction

Design can be seen as the process of creation of what is not there, and what is ought to be (Nelson & Stolterman, 2012). One of the main problems of this complex process is the gap that is created between the design ideal space and the real contexts (of production, of use, of end-life, etc.) (Hermans, 2015). To cover this gap, a constant conversation is needed, between all possible stakeholders of the design process itself. Thanks to this conversation, which can be seen as Second-order Cybernetics, the actors learn about what conserves and what changes in the designed solution thanks to the context/environment (Dubberly & Pangaro, 2015), which can also be seen as the manifestation of what we defined as re-appropriation process (Ostuzzi, Conradie, Couvreur, Detand, & Saldien, 2016), a process of change and adaptation of the product which is driven by highly context-dependent and often tacit knowledge (Von Hippel, 1994)(Sanders & Stappers, 2012). Because of its context-dependency the conversation can occur only in time and in the real contexts of production, of use, etc. To facilitate the conditions for this conversation to happen, which is ultimately a design act done by others, meant as non-designers including non-human actors, a second-order design is advocated
The definition by Dubberly et al. of second-order design as “[The signage system] is never completely finished, never completely specified, never completely imagined. It is forever open.” (Dubberly & Pangaro, 2015, p. 7) closely resembles the definition of Open-ended Design (OeD) defined as the outcome of the design process that is “able to change, according to the changing context. Open-ended Design, can also be defined as suboptimal, error-friendly (Manzini, 2012), unfinished, Wabi Sabi, contextual, context-dependent and is characterized by its inner flexibility due to the voluntary incomplete definition of its features, also defined as its Imperfection.” (Ostuzzi, Couvreur, Detand, & Saldien, 2017). Open-ended Design becomes therefore an illustration of second-order design, being a learning process about what conserves and what changes in the designed solution. It starts from reality and it aims at reality, creating a loop of information (feedbacks and feedforwards) that can reinforce or balance each other, helping the designer in overcoming the possible paralysis occurring when facing complexity. In other words, it supports the designer in understanding what can be left open, being never completely imagined, or unimaginable, but yet possible and probable. For this reason, to think in order of Open-ended Design, or second-order design, means to anticipate what, of the proposed design object, changes (can potentially change or should possibly change) once put in contact with reality. These design attributes, that we define as context-dependent, in an Open-ended Design outcome are deliberately and meaningfully left open, giving space to the context to take part of the design process, fostering conversation and letting this information emerge from reality instead of imposing them. All the other design attributes should be, on the contrary, defined and imagined as stable, since Open-ended Design is created only through balancing controlled and out-of-control, and should not drift to completely open and un-organized design outcomes. The function of Open-ended Design materializations could be compared to the one of prototypes, with the difference of triggering a learning process throughout the whole life span and not only in the front end or pilot productions phases (Björgvinsson, 2008). This implies the importance of the engagement of the designer with his/her own creations, during their lives in order to learn about the interactions with the world. This engagement can be facilitated, also after encounter, by the use of the internet which can trigger conservations between different stakeholders, and by intensifying the feedbacks readability (which is done through meaningful imperfections).

Open-ended Design methodology, an overview

The Open-ended Design methodology is mainly rooted on iterative dynamic processes of observation and anticipation, where observation is based on feedbacks, and anticipation on feedforwards. This iterative process aims at implementing the observed systems in terms of resilience and should be actualized through a design action. In order to support the designer while facing complexity, possibly reaching the paralysis that slows him/her down from taking actions, the method has been proposed and ten lenses created. These ten lenses can support the designer by offering new perspectives on complex situations and, looking at them one by one, by giving some partial answers. Merging the ten lenses back together, which is a profound creative act (by nature driven by tacit and contextual knowledge), the designer can anticipate possible futures, undergoing a design action in Open-ended form. This action, according to the presented method, is not a solution and is not fully finished, as it is – on the contrary – a mean to learn and explore further realities. In other words, Open-ended Design is a mean to better define the question, and start a conversation, rather than to give a definite answer. For these reasons, once the Open-ended outcome is realized, it is fundamental to keep observing it, in
order to learn and continuously improve. These topics are already addressed in software development, but little has been done with special focus on the material aspects of the designed products. Also, what in theory has been described, gives little support on how to take specific actions in practice. Therefore, this whole dissertation aims at supporting designers while designing hardware products, by merging both practice and theory in one framework.

To summarize, the here proposed method is structured as follows:

1. Observation of reality (supported by feedbacks), in order to identify traces showing the occurrence of spontaneous processes that bring products from ideal to real statuses. This can be supported by the ten lenses, in order to highlight specific aspects related to change.
2. Anticipation of reality (supported by feedforward, in form of Open-ended outcome).
   a. Definition of the main hypothesis that embraces the spontaneous process, attempting at making it less disruptive or more beneficial (see Figure).
   b. Materialization of the outcome needed to explore the hypothesis. This outcome has an Open-ended nature and is based on specific, contextual and creative mechanisms and strategies (or new compositions of the ten lenses).
3. Observation of reality (supported by feedbacks), in order to verify the previously identified spontaneous processes and the (non-)confirmation of the main hypothesis.

Figure 1: Open-ended Design methodology as iterative process of observation-anticipation bridged by action

Research method

Many aspects of the presented method should still be tested. With the following, and final, experiment we don’t aim at reaching exhaustive answers, but rather to explore some of the following concepts:

- Can designers understand the complex dynamic of change in design, represented by existing Open-ended Design solutions, and achieve more general understandings? In other words, can designers autonomously use the propose method to analyze existing cases?
Can designers re-apply meaningfully their understandings in new contexts?

The test involved 16 students of 3th year Industrial Design Engineering, within the framework of the course Cybernetics and Systems Thinking. This course is project-based (Lee et al., 2010) and focuses on small communities. Goal of the course is the students’ interaction with a real local community which, thanks the constant use of functional prototypes and observations of the occurring interactions, should start a self-sustaining process. In other words, students have to provide a solution meant to function and last, in time, also without their presence. We decided to select only few of the 16 cases as example to describe the general flow as approached by students. These cases represent examples that managed to follow the entire flow and draw more general conclusions out of it. At the end of the chapter, sections describing the disturbance encountered thanks to this test, and the overview of results of all the 16 cases, are reported. The experiment is divided into two tasks, structured as follows.

A specific of an existing product corresponding to the Open-ended Design definition was assigned to each student. These cases were selected by the instructors of the course. The selection focused on products of our daily life (chairs, shoes, vases, houses, etc.) and not on assistive devices, for two main reasons: (1) we wanted the students to already have a tacit knowledge about those products, built in the years of interaction with them, in order to be able to highlight spontaneous processes and other dynamics and (2) we still struggle on finding good, open-ended examples, of assistive devices with enough re-appropriations already occurred and shared, with exception of 3D printed ones. The OeD method, as previously described, had to be followed in the analysis of these already existing design outcomes. In this way the whole analysis result in fact as a post-factum activity. No importance was anyhow given to the coherency of the analysis with what the designer “might have thought” in reality while developing his/her own creation. We focused on the comprehensiveness and soundness of the students’ analysis, and on their capability of finding connections adopting a broader. This task was addressed as written report, inclusive of visuals and text.

Results

This task proved great interest, since students elicited various insights on the method itself and both helped in clarifying controversial aspects and valorizing some previously considered, for example, less important. Here following extracts from two students’ works are reported (see Figures), in order to give a first overview on their approach. The examples report 1-1 extracts of words and images, as proposed by students. Specifically, the reported sections present:

1. Spontaneous process
2. What can the designer learn?
3. Controlling solution (in its causal modelling)
4. Hypothesis
5. Open-ended solution (in its causal modelling)
Verderame by Fioravanti, analysed by Rik Maes

Spontaneous process

“When, for example, a wooden floor is observed during its lifetime, changes can be observed because the wood will decay over time. That’s why wooden floors need a finish to last longer. When this kind of floor is observed over a very long period of time, the finish will be worn off due to people walking over it and damaging the finish of the wood. When people walk over the floor they scrape off small pieces of the wood finish. This behavior is spontaneous: people cannot walk over a surface without damaging it.”

What can designers learn?

“Due to this visible decay, the designer can learn how and where people move in a certain environment. He can also see which places are more frequented than other places thanks to the severity of the decay. He can conclude that the appearance of the floor will change when it is used more frequently.”

Controlling solution (see following Figure)

“The whole system is already an archetype: Limit to growth. [...] The controlling model as depicted in green is based on fixing the problem of the decaying process. When the decaying process of fixed, the central reinforcing loop that describes the spontaneous process will become a self-destroying process and so it will eliminate the spontaneous behavior. By adding more finish to the floor or re-do the floor more frequently, it will increase the look and feel of the floor, which will attract people whom will increase the amount of wear and tear of the floor. These fixes will prolong the inevitable, the floor will decay eventually and the spontaneous process will happen.”

Hypothesis
“The appearance of the floor will change when it is used more frequently”.

In figure: Controlling solution, design and interpretation by Rik Maes

Open-ended solution (see following Figure)

“Verderame gives a clear feedback to the designer, thanks to the material properties of copper, the usage of the product is clearly visible to the designer. The designer can learn the general movement of people in a certain environment. The model above is based on assumptions and can differentiate with reality. This is a self-reinforcing loop that will balance itself out when the product is completely oxidized and the path is made. The path has to be “maintained”, when there is a lack of movement for a certain period of time, the tiles will start to oxidize again, resetting the path.”

In figure: Open-ended solution implemented in Verderame, design and interpretation by Rik Maes

(2) Underskog by Bjaadal, analysed by Lucas Wyffels

Spontaneous process
What can designers learn?

“A designer can learn three things from this: (1) A normal fabric that undergoes wear and tear becomes ‘ugly’. It is one of the reasons why the chair is being thrown away. (2) When a hole appears in the upper layer, the layer underneath become visible. (3) The use of the seat over time causes the appearance to change.”

Controlling solution (see following Figure)

“What a conventional designer/engineer is doing now is minimizing as much as possible the damaging of the chair. This by searching constantly solutions on how to make the seat last longer so the input to ‘reinforce the seat’ overwhelms the ‘time of occupation’. For example: more reinforcement means less damaging what more attractiveness gives. This results in more occupation and again more reinforcing needed! This is an escalating situation and is shown in the following model in orange [...]. The constant reinforcing of the chair can cause designers a headache because she’s being limited by time and resources. In short: there is a limit to growth. The model can be extended. A limit to growth situation can lead to a failure of the product if it cannot cater the needs of the chair. Another approach to make the chair last longer, is needed.”

Hypothesis

“The product changes over time because it is being used, what makes it a spontaneous process with, in some cases, an open-ended aspect: a Wabi Sabi seat. This means that it can trigger an extra appreciation when the seat show marks of usage.”
In figure: Controlling solution, design and interpretation by Lukas Wyffels

**Open-ended solution** (see following Figure)

“In case of the Underskog, the designer decides to not reinforce the seat, but to change the negative feedback given by the damage, into a positive feedback. This causes a reinforcing loop of the used chair. Of course, the more the image appears, the less the fur of the seat can be damaged, what causes the reinforcing loop to stabilize”. […] “Again, we have here a limits to growth loop. The solution would be another extra element that neutralizes the balancing part of the loop, but we won’t go further on this. What is improved? The spontaneous process has taken over the entire loop and brings rest to the designer (no reinforcing of the chair is needed). While a normal chair will be thrown away when the seat decays, this seat will be exciting for a longer period of time as seen in the graphs below.”

In figure: Open-ended solution implemented in Verderame, design and interpretation by Lukas Wyffels
Discussion

As anticipated, this final Study elicited interesting reflections and opened up new possible future studies. About Task 1 is possible to state that the overall method proved to be adopted meaningfully, and still some parts need implementations. First of all, the majority of students was able to highlight the spontaneous processes, or more, that the assigned case study tackles. This is probably due to their specific formation on systems thinking, and it should not be forgotten as to analyze post-factum creations is simpler than to anticipate not-yet-existing ones. Interestingly, some students identified spontaneous processes specifically related to their student life (i.e. distractions during study, social status of personalized shoes), this underline as they adopted a very personal view, and managed to somehow find other meanings in already existing solutions. Two students missed the identification of the process, which implies a lack on the understanding of the “Why?” lens. Similarly, one student identified the spontaneous process, but missed in understanding its relevance in more abstract terms (with reference of Una Seconda Vita, a bowl that in case of fall and breakage acquires a second function, we can read “Why in god sake would you ever drop your fruit bowl?”). Some students included images of other products of the same category, in order to highlight the occurring spontaneous processes, we imagine that almost everyone would have used more pictures of the observation if undergoing personally the first co-design process. This aspect could be further explored in future studies.

The model of reality, through archetypes, was also well developed by the majority of students, which could be again be linked with their specific knowledge. The most common archetypes used to describe the controlling solution are: limits to growth, fixes that fails, growth and underinvestment, escalation, shifting the burden. On the contrary, very little archetypes have been used to represent the new proposed solution (they just represented the circular causality, without attempting at finding patterns). This could be related with many different aspects: the assignment didn’t explicitly ask for this link or, for example, students expected to see the final solution as optimal one, and therefore not failing. Only a couple of students actually highlighted the limits of the given solution, explaining how their proposed solution was also subject to potential changes in time. It might be that students failed in seeing the circularity of the process and, once analyzed the solution they considered it “final”. This of course could represent a big threat, which could lead to the same dynamic with designers engaging in change in design (which is indeed something we could apply for some of the collected cases): to see only the first loop after release, and consider it as final. About the lenses only few problems were encountered: the why sometimes overlaps with the mechanism (i.e. Why does the product change? Because of a certain choice with regard of the materials). More importantly to the question “What is changing in the product?” almost every student (15 on 16) answered the question with the description of the mechanisms. Thanks to the interview feedbacks were given and an optional question resulted be “What design aspects are changing in the product?”. Also the lens “When?” was sometimes misinterpreted with the exact moment, and not the general Life cycle (i.e. When is the product changing? Once the material is scratch - instead of – during the use phase). This, again thanks to the interview, resulted in the suggestion of creating more specific questions (from “when is the change happening?” to “when, in the life cycle of the product, is the change happening?”). The last lens that created some problems is the How? Strategy. This can be implied to the fact that these students have no background on business models, and therefore might miss the meaning and relevance of such perspective. On the contrary the mechanisms, therefore the
technical aspects of the solutions, were clearly identified and described. About the lens Who? Many students added the designer as answer, referring to the fact that the designer him/herself changed the product at first place. This is not the intended use of the lens, but it is reasonable as an answer and therefore considered valuable to highlight as the Open-ended outcome is always result of a design choice.

Finally, to almost every student resulted hard to identify other examples where to apply the same dynamic. Indeed, this is a hard request to be done without a context and requires probably time to identify a reasonable answer. Even if examples were provided they had two characteristics: or they were the exact copy of the introduce product (i.e. the students who analyzed Verderame suggested Verdegris, a table using the same material to obtain similar effects in time), or they were actually representing a slightly different dynamic (i.e. the student analyzing Do Scratch, a lamp that functions only if scratched, suggested a comparison with the rat look of cars, which are intentionally scratched for aesthetic reasons). These dynamics were asked during the interview, where it resulted clear the difference in certain lenses.

We can imagine more difficulties in translating the learned concepts into a new context, when discussing it with students only few of them created a clear link between traces of change in their prototypes and the way they explored their hypothesis. The main problem, mentioned by the majority of students, is time related. In fact, the possible mechanisms they were coming up with required more time than the test itself (which lasted more or less one month). In this perspective it was probably a mistake from the researcher side to try to obtain similar results within a short time span, since we acknowledged already earlier as some processes cannot be speed up.

**Conclusion and future studies**

Students applied practical Open-ended Design solutions, or second-order design solutions, to start a conversation, through design, with different stakeholders. Here, the voluntary designed imperfection of the system served as trigger for re-appropriations, which helped the designers in learning about the real interactions with the system itself. This experiment stresses the need for teaching systems thinking skills for designers, focusing on the fundamental capabilities as anticipating possible scenarios and losing control on the designed object. Also, it stresses the importance of practical examples and strategies to achieve and support re-appropriation processes in real-life experiments. These strategies cannot be taught to students as “fixed realities” being highly related to the context, but can be introduced to them as inspirational and comparative tool. By doing that, the actual Open-ended Strategies analyzed, and in some cases created, by students became the expression of their creativity as designer, and served their personal perspective in understanding the complex phenomenon of change. The main conclusion that we can delineate here is that we observed students changing, by observing the change in other products. They proved to have learned to think in the direction of time and of spontaneous processes. This mutual change is after all, the core of second-order cybernetics and main goal of second-order design, possibly in form of Open-ended Design.
In conclusion Open-ended Design is here proposed as methodology that characterizes objectives, techniques, and processes for creating new design outcomes. It provides a working routine, more similar to a pathway, rather than a strict procedure. In this perspective, Open-ended Design is hardly comparable to other approaches (i.e. co-design, UCD, etc.), not for its positioning but for its very nature. In fact, Open-ended Design advocates the engagement with Participatory Design actions, that could be conducted in many forms becoming sometimes user-centered ones, waste-centered, etc. depending on the specific context. OeD is supported by a “blend of more than one systemic methodology” (K.M. Adams, 2015) all focused on the understanding and management of the controversial nature of change in its unavoidable spontaneous events.

References


