

A RESEARCH THROUGH DESIGN FRAMEWORK FROM THE EVALUATION OF A META-DESIGN PLATFORM FOR OPEN AND COLLABORATIVE DESIGN AND MAKING PROCESSES

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ABSTRACT

The democratisation of technologies, knowledge and activities have been changing the world of designers, blurring the boundaries between amateur and professional designers, especially within the connected phenomena of the Maker Movement and Indie Designers. Within this context, how can collaborative design processes be documented, analysed, managed, shared? This article investigates the role of meta-design digital tools for the facilitation of distributed systems of creative agents, formally trained and informal amateurs that collaboratively design and produce artefacts. It documents a research study organised for testing a digital meta-design platform with users and the researcher as meta-designer: the results provide insights for improving the platform but also for building a comprehensive research through design framework that connects meta-design research and practice for exploring the role and nature of meta-design and meta-designers in facilitating collaborative design processes starting from their description with digital ontologies.

Keywords: Platform strategies, Research methodologies and methods, Collaborative design

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1 INTRODUCTION

Design is inextricably connected and influenced by technology, economy and society, and by all the interactions emerging among them. The democratisation of technologies, knowledge and activities have been changing the world of designers, both at individual level and at organisational level. For example, the boundaries between amateur and professional designers have been blurring at individual level (Gerritzen and Lovink, 2010; Manzini, 2015). The same happened to the boundaries of organisations as well, either with the addition of organisational complexity and change of scale with meta-organisations (Ahme and Brunsson, 2005) or with the boundaries becoming increasingly porous thanks to open innovation initiatives that increase the exchange of intellectual properties and expertise (Bogers *et al.*, 2018). When the structure of the organisations and boundaries between amateur (or better: non-formally trained and non-professionally experienced designers) and professional designers are changing and becoming uncertain, the task of addressing the responsibility for future organisations and for future designers are intertwined. By adopting a meta-design perspective, new possibilities have emerged for designers to be active agents in the organisation and management of collaborative and distributed processes, especially design and making ones. How can be collaborative design processes documented, analysed, managed, shared? This article focuses on the tools, capabilities and approaches that future flexible, fluid, open and distributed designers and organisations can adopt in order to evolve along these changes. The context of this research is defined by the emerging phenomenon of the Maker Movement (Anderson, 2012; Gershenfeld, 2005): untrained amateur designers and professional designers producing their projects independently, with a more advanced awareness and knowledge of technology, which further merge design and engineering through the ability of designers to write software, develop electronics and define and set up manufacturing processes. Within this context, this article proposes an approach for testing the modelling and management of design processes and their organisations, in order to support distributed collaborative design processes that are open to participation of different kind of stakeholders. The focus of the article is on how developing a meta-design ontology into a digital platform can be helpful for designers in facilitating their collaborative practice and in redefining their work. Design here becomes increasingly a software development activity, representing thus another potential direction for engineering design.

Design research and practice are not always connected, and within this relatively recent and emergent context their integration is an even more complex issue. In order to contribute to the reduction of this gap, this article elaborates a research through design (RtD) framework that bridges the practice of Makers and their facilitators (or meta-designers), with the meta-design practice and research. The RtD framework here presented connects both practice and research, data formats and digital platforms, researches and experiments for exploring the role and nature of meta-design and meta-designers in facilitating collaborative design processes starting from their description with digital ontologies. The foundation of this framework can be then found in the digital dimension of the infrastructure that enable collaborative processes: from a digital ontology that describe design processes to digital platforms that enable the editing and visualisation of such ontology to the practice and its research. The approach adopted in this article is thus to elaborate an RtD framework on top of the practice and research of developing such a digital meta-design platform and testing it with users: the importance of the RtD approach can be found here in the focus on the insights gathered from the platform, rather than on the development of a complete product or the elaboration of generalised insights from research, in order to elaborate future strategies. The RtD framework is therefore based on both theoretical research, meta-design practice and on the profiles and expectations of (potential) future designers and the role of the researcher/meta-designer in this context order to build a framework for future research and practice. This article represents the summary of a research study but also of years of research, on both theoretical and experimental work, and the RtD framework is both a conclusion of this path and the strategic plan for future work. These are the research questions addressed by this article:

1. RQ1: how can we connect the research and practice of meta-designers in open and collaborative design and making processes?
2. RQ2: how can we facilitate meta-designers with digital tools for the facilitation of open and collaborative design and making processes?
3. RQ3: how can we adopt and test these digital tools in order to improve them and their contribution to the profile of meta-designers?

In order to support RQ1, RQ2 focuses on the development of a digital meta-design platform and RQ3 on presenting and documenting an approach for testing the digital meta-design platform. Finally, RQ1 connects meta-design research and practice by elaborating an RtD framework following Redström's approach (2017) on top of the structure and the results from the research study (following the approach addressed by RQ3) of the digital meta-design platform (addressed by RQ2).

2 DIGITAL META-DESIGN ONTOLOGY, PLATFORM AND PRACTICE

How can we facilitate meta-designers with digital tools for the facilitation of open and collaborative design and making processes? (RQ2). This context of distributed systems of creative agents, formally trained and informal amateurs that collaboratively design and produce artefacts, can be described for many aspects: adoption of digital fabrication technologies, the importance of community-based initiatives and of the collaborative practice behind both design and making. One of the common elements emerging is the new understanding of designers as facilitators and organisers of open, distributed and collaborative socio-technical systems made of creative and productive agents. The role of designers can take many forms, from the traditional role of form-givers, to the role of sense-makers, and ultimately to the role of organisers of the contexts for complex and multi-agent and multi-stakeholder design processes. This role moves designers from the Design perspective to the Meta-Design one: rather than directly designing artefacts themselves, designers focus instead on designing the tools, contexts, rules and systems that enable more actors to design. From taking part in design processes, to modelling and managing design processes. Within design research, design processes have been studied along three directions: a) design as the work done by designers, with a study of the actual practice (Cross, 2006), b) design processes described with ontologies (Green *et al.*, 2014) and c) design processes facilitated by meta-design approaches and initiatives (Fischer and Scharff, 2000; Giaccardi, 2003). Design processes can be characterised by a distinct '*designerly*' form of activity and ways of knowing different from the scientific tradition based on people, processes and product (Cross, 2006). Their research, however, has a relatively short history, where models are highly edited and rationalised abstractions of reality but disconnected from the actual practice and with limited consensus on their structure (Green *et al.*, 2014). Joining these two polarities, rather than studying existing processes, the Meta-Design approach focuses instead on designing environments and tools for facilitating the emergence of design processes: it can be a way to leave space for user participation in the design process even after the design concludes ('*design-after-design*') (Ehn, 2008); it can be a way to extend designed systems beyond their original nature, and because it includes the ongoing process in which stakeholders become co-designers, but taking place not only at the time of design implementation, but throughout the whole existence of the system shifting the control of the design process from designers to the hands of the users ('*designing the design process*') (Fischer and Scharff, 2000). Meta-Design is a rich emerging design culture that enable possibilities along more than one direction: Giaccardi (2003), crossing etymological facts with extensive literature review identifies three different declinations of Meta-Design where '*meta-*' is regarded as: 1) *behind* (or *designing design*), 2) *with* (or *designing together*), 3) *between/among* (or *designing the "in-between"*). The idea of *designing design* was explored also by Duffy (2002), who also worked on ontologies of engineering design activities (Sim and Duffy, 2003) with a strong focus on input and output of knowledge. Engineering design of design processes could then be applied directly to design processes or to the engineering of the digital meta-design platforms for the discussion of design processes (Figure 1).

Design processes can be then modelled, managed and researched by connecting both design research and practice through meta-design, and the framework behind this article, called OpenMetaDesign, has been developed by integrating Service Design, Activity Theory and Meta-Design. Service Design and Activity Theory provide the concepts and tools for understanding and designing activities, and Meta-Design provides the concepts for applying this to the reflexive and conscious design of design processes (Menichinelli, 2018a, 2018b; Menichinelli and Valsecchi, 2016). OpenMetaDesign has been encoded in a digital platform that aims at enabling users to meta-design collaborative design activities as ecosystems of activities. The platform integrates realtime edit and chat functionalities that provide a visualisation of collaborative design processes (and their discussion) through the elements of: activity, time, participation, boundaries, resources, flows. Such visualisation can be described as Gantt chart of Activity Systems with flows of resources among them as in a System Map organised according to a Service Blueprint. The platform is based on a data format describing the ontology of

design processes in the context of the Maker Movement, with the focus of processes as a set of activities and dialogues about them. Activity Theory is the conceptual basis for the ontology of the data format, since it is a framework for orienting researchers in understanding complex socio-technical phenomena. The data format and its ontology are encoded in the software that handles the visualisation and the users interactions. On the platform, projects can be edited in their general title, description, version and community (Figure 2), then the processes can be edited in terms of activities and flows and contradictions between them along a time axis (Figure 3). A video of the demo of the platform, as tested in the experiment, can be viewed on YouTube ([openp2pdesign, 2018](#)), and the fully working code is free/open source software available under the AGPL license and can be quickly deployed with Docker ([Menichinelli, 2019a](#)).

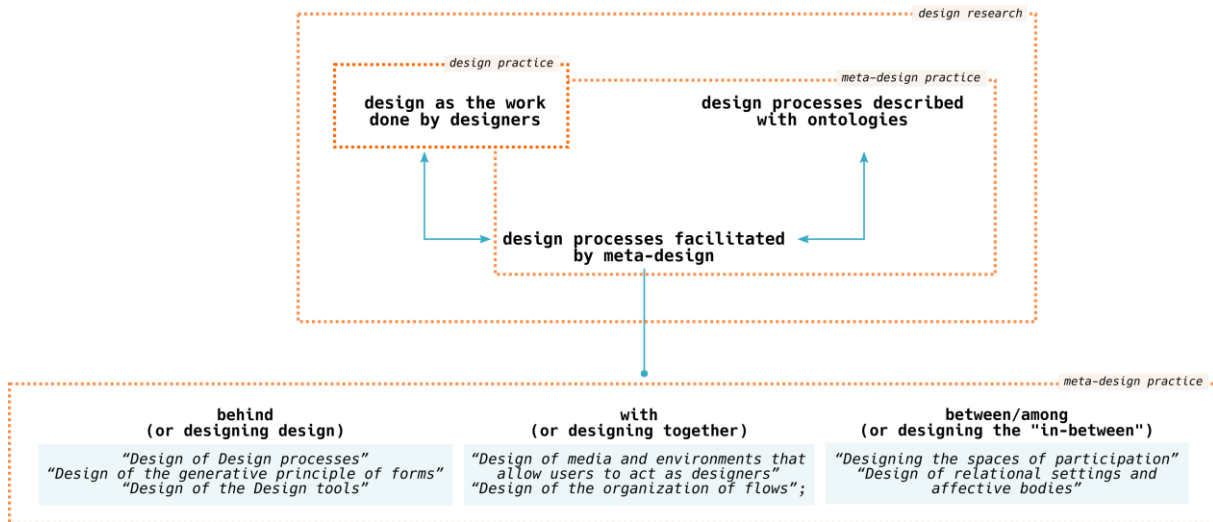


Figure 1. The research and practice connections among design processes and meta-design

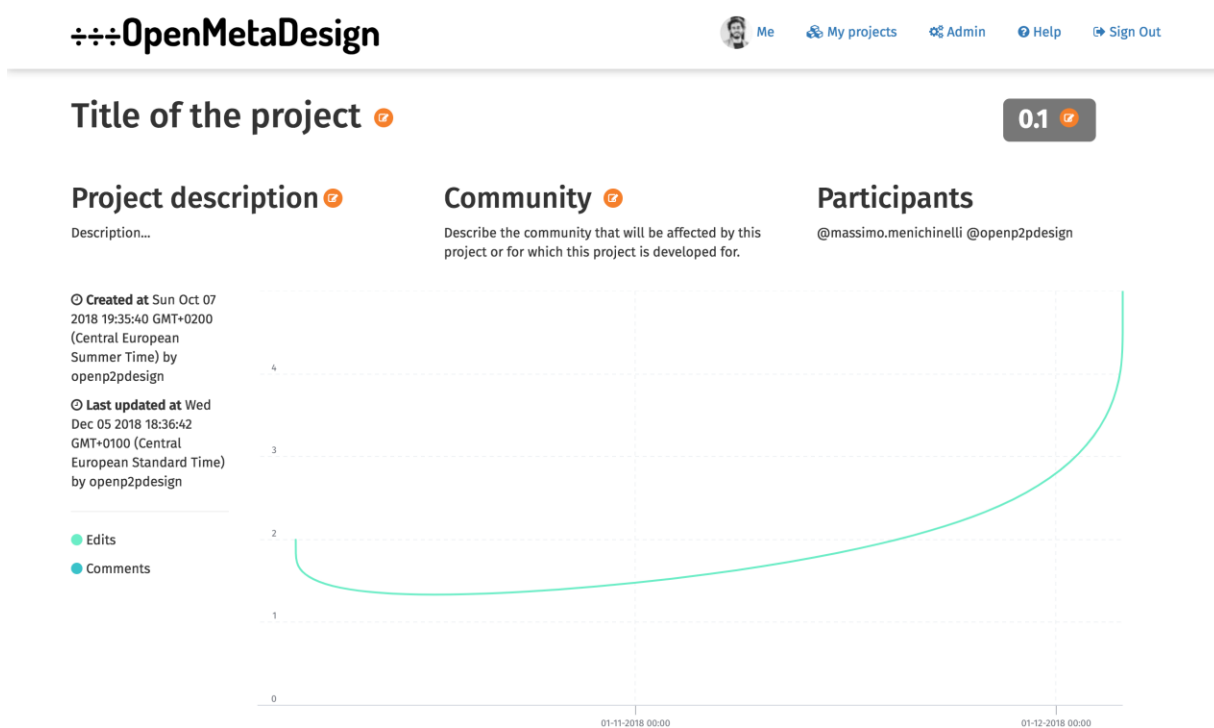


Figure 2. The OpenMetaDesign platform: first section of the Project page

Processes

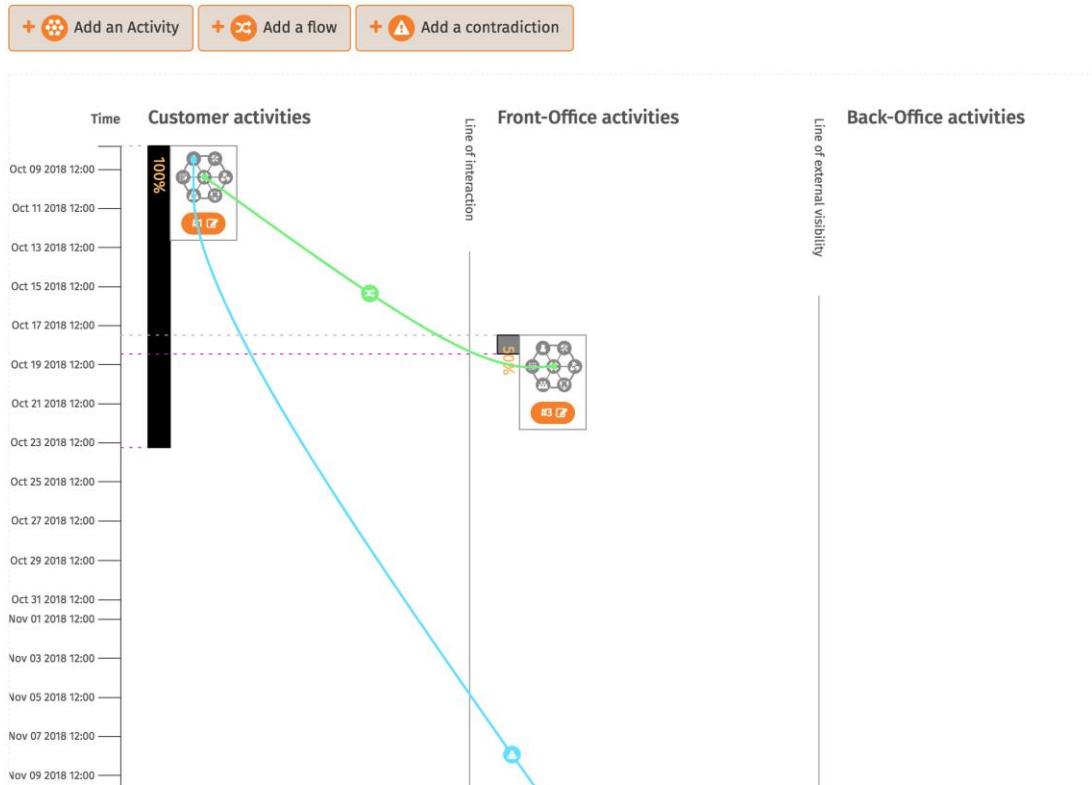


Figure 3. The OpenMetaDesign platform: second section of the Project page

Data Views

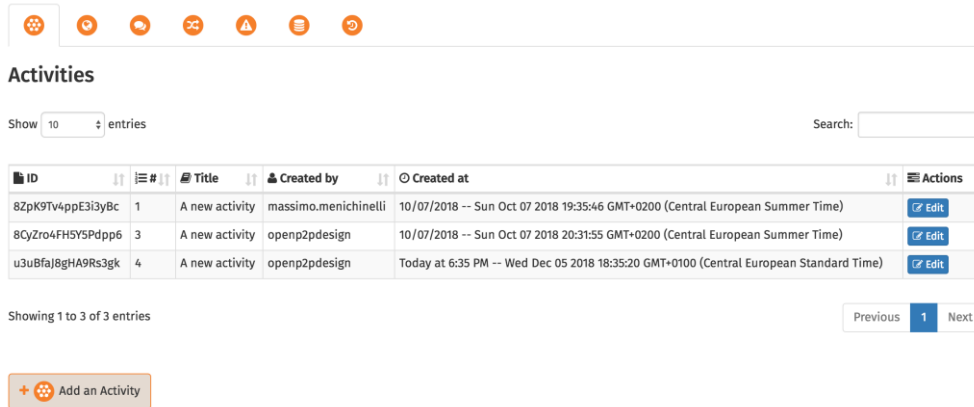


Figure 4. The OpenMetaDesign platform: third section of the Project page

3 TESTING A META-DESIGN PLATFORM

How can we adopt and test these digital tools in order to improve them and their contribution to the profile of meta-designers? (RQ3). This section documents a research study organised for testing the digital meta-design platform with users and the researcher as meta-designer, elaborating the main key results that contribute to the definition of the role of meta-designer and of digital tools in this practice. The research study took place on 16th October 2018 in Polifactory, the makerspace of the Politecnico di Milano (Italy) and consisted in a presentation of the OpenMetaDesign framework and digital platform, followed by a test session of the first stable version of the digital platform (Menichinelli, 2019b) and finally with a questionnaire for the participants, which was structured with these sections: S1) *You*, S2) *You and Making*, S3) *You and Open Design*, S4) *Organisation in your open and making*

practice before this research study, S5) Organisation in your group during this research study, S6) Interactions in your group before the research study, S7) Interactions in your group during the research study, S8) You and OpenMetaDesign. The full questionnaire is available online in a reusable format for the LimeSurvey software (LimeSurvey Project Team and Schmitz, 2015), as a readable PDF file exported from it, together with the software developed for analysing the data and all the generated charts and therefore the results of each question (Menichinelli, 2019c). An improved and stable version of the platform was released after reflecting upon the test (Menichinelli, 2019a). During the research study, 9 participants (all of them Italians) tested the platform and 8 completed the questionnaire, working in 4 groups of 2 participants each one (S1).

They mostly identified their gender as female (5 out of 8 participants) rather than male (3/8); their age was mostly 22 years old (3/8), which is also the lower age among participants (higher age is 32) and the mean age is 25. They all had a background in design (7/8) except for one participant that had it in computer science, in terms of education they mainly have a BA (5/8), then an MA (2/8) and only one participant had completed a doctorate. Their work experience covered different typologies, from just students and interns to social media managers, consultants, product designers, researchers and teachers (of design and even of meta-design). Their interest in future work mainly comprised game design, interaction design, product design, freelance work and research. These profiles determined the context of the open and making and related meta-design practices: the results of the research study apply to this context, and different contexts might result in different feedbacks about the ontology, the platform and the role of the meta-designer. In their experience with making (S2), participants had been mainly interested in making between 1 and 5 years (4/8) or for more than 10 years (2/8). Some of them considered themselves as makers (3/8) or even experienced makers (1/8), but the majority of them did not think they are makers (5/8). Two of them considered themselves as researchers, and at the same time not as makers. Professionally speaking, making for them was mainly either a hobby (3/8) or a secondary professional activity (3/8), except for one participant, and another participant did not answer. Their ambition towards the Maker Movement was strongly research-oriented (5/8), socially-oriented (4/8) and local community-oriented (3/8), while technically-oriented ambition was less strong and policy-oriented ambition showed mixed results. Regarding their connection with Open Design (S3), they were almost all (7/8) interested in adopting Open Source software, hardware and design to some of their future projects. Participants stated that they would mostly release design projects (5/8) and documentation of the process/manufacturing/use of the projects (5/8) as open source; 2/8 of them would use existing open source software or design in their work. The release and use of open source hardware projects was limited to one participant. Participants found interesting Open Design especially for collaboration (5/8), sharing and access to information (4/8), modification and use for personal fabrication to a lesser extent (2/8). None of the participants considered to understand the concept of Open Design and its implications completely, but most of them stated that they understand most of it (3/8) or something of it (3/8), and only one participant did not understand it at all. Interestingly, none of them reported to have difficulty in understanding its concepts and philosophy or its tools for managing the resources and files. Most of the difficulty was found in understanding Intellectual Property concepts, applications and strategies (4/8), business models (4/8) and tools for the coordination of collaborative processes (3/8), such as the OpenMetaDesign platform. Along this direction, it is important to note that participants could adopt Open Design better with proper tools for the coordination of collaborative processes (sequences of activities) (4/8) and tools for the coordination of collaborative systems (actors, roles, interactions, organisations) (2/8). The questionnaire then explored organisation in participants' open and making practice before the research study (S4). Participants reported that they had never noticed any organised process, everything was decided at each moment (3/8) or that there was at least sometimes processes with a certain structure, and they had understood it and designed it with other people (3/8). In terms of whole systems (actors, roles, interactions, organisations, places), they at least sometimes had understood a system with a certain structure (3/8) and to a lesser extent they had also designed it (2/8). Furthermore, collaboration was reported as mainly a collaborative discussion about the project but work on individual projects/components (4/8) and to a lesser extent the collaborative design of the same files/components (3/8). During the research study instead (S5), the digital meta-design platform affected these dimensions more positively regarding the understanding the whole systems of collaborative processes (actors, roles, interactions, organisations, places) (5/8) than the understanding of processes, split between the understanding of processes (3/8)

and a lack of understanding of processes with decisions taken at each moment (3/8). Half of the participant found collaborative discussion about the project but work on individual projects/components (4/8) and some of them found no collaboration at all (2/8). In terms of tools (more specifically: the percentage of their usage in the coordination of collaborative activities), previously participants have mostly collaborated with face-to-face interactions (45%), then with file storage services (Google Drive, DropBox) (20.375%) and mobile messaging (WhatsApp, ...) (11.875%). Interestingly, typical open source communities tools had been used very little: only 2 participants reported a small usage of mailing lists, and direct e-mail usage (4.125%) and version control repositories (such as GitHub) (5.375%) are low. Even project management platforms such as Basecamp had been used very little (3.375%), much less than realtime chats like Slack (8.125%) but much more than main social media platforms, with both Facebook and Twitter at less than 1%. For the participants, coordination of collaboration had been mainly an issue of face-to-face, file sharing and chatting discussion. The questionnaire then compared interactions in the group before the research study (S6) with the ones that took place during it (S7). Before the study, collaboration within the groups was reported by participants in the questionnaire as generally high, even if with some asymmetry between participants; interactions generally increased in frequency for all groups but one; quality of interactions remained the same, except for the group with highest collaboration before and a single participant. The last section of the questionnaire investigated how participants perceived the digital platform (S8). Usability of the platform was assessed with the System Usability Scale (SUS): participants were evenly distributed between agreeing, disagreeing or neutral (neither agreeing or disagreeing) in terms of using it frequently. With SUS, participants found the system unnecessarily complex (half of them agreeing, two strongly agreeing), and while 3/8 strongly disagreed and 2/8 disagreed it is easy to use, 3/8 is neutral; furthermore, as rather positive result, 5/8 of participants was neutral about the platform being difficult to learn. Results were polarised regarding the amount of things needed to learn before using it (3/8 considered less things, 2/8 instead considered more things). Functions of the platform were well integrated (4/8 agrees) and rather consistent (4/8 neutral and 2/8 disagreed about its inconsistency). Interestingly, participants stated the need of the support of a technical person to be able to use the platform (4/8 agrees and 2/8 strongly agrees). The platform was therefore complex but not too difficult to use and did not require too much knowledge for its usage; however, participants were not confident about using it (4/8 strongly agrees) because it was considered too cumbersome (3/8 agreed and 2/8 strongly agreed), and the help of a person was of critical importance. The platform was found useful for discussing activities (4/8 agrees), the organisation of projects (3/8 agreed and 2/8 strongly agreed), then flows (3/8 strongly agreed), processes (3/8 agreed) with a 3-3 polarisation between agreement and neutral position projects and problems in projects. Participants mainly suggested to improve the Projects section (half of them strongly agreed, two agreed) and the discussion, chat, messages among users (half of them strongly agreed, three agreed). Participants suggested to make the platform more visual and with less text, generally with a more refined User Experience (UX) / User Interface (UI) and pointed out bugs and technical issues. Terms, concepts and the location of functionalities should be clearer; help sections should be part of the functionalities and not on a separated page. The activity of other users should be visible in realtime, and the chat should be improved by merging all the chats into a single one in a sidebar. Finally, participants rated how the platform could contribute to the development of the Open Design and Maker movement, especially with the improvement of the design of open and collaborative projects (5/8), of the supply chains (3/8) but not of the manufacturing of open and collaborative projects (0%). The platform was considered also useful for improving the organisation, coordination and collaboration within the networks of Maker laboratories (Fab Lab, Makerspace, Hackerspace, ...) (3/8) and inside a single Maker laboratory (3/8). Less importance was given to the possibility of connecting Maker laboratories with non-maker organisations (companies, craftsmen, universities, workshops, associations, ...) (1/8) or with a larger audience (1/8). The open questions of the questionnaire were manually coded into segments, and this analysis showed the importance of improving the interface and the chat systems: *UI* (21.82% of coded segments), *Chat* (14.55%), *No clear idea* (9.09%), *Bug* (5.45%). Then key elements of the organisation of design processes were identified in *Tasks* (12.73%), *Small Groups* (10.91%), *Roles* (5.45%). Finally, in terms of perspectives and metaphors for understanding processes, the key identified elements were *Text* (3.64%), *Branches* (5.45%), *Gear* (3.64%), *Complexity* (7.27%). Three metaphors for understanding process emerging here: as texts, as mechanisms or complex systems.

4 DISCUSSION

How can we connect the research and practice of meta-designers in open and collaborative design and making processes? (RQ1). This section elaborates a research through design framework that connects meta-design research and practice, based on the digital meta-design platform and its research study. The research study provided useful information regarding the profiles of the participants as Makers, and for improving the platform. Since just the first version was tested, the results shows that it need improvements, while already pointing to potential changes in terms of UI, functionalities, approach and metaphors for the visualisation. For example, the importance of the chat system clearly emerges here, along with the idea of moving towards a more visual and less text-based visualisation. The mixed results in understanding processes may be explained by a combination of the realtime functionalities and by the little time available for testing the platform, leading to a less understanding of processes as a whole and more focus on decisions taken at each moment. Furthermore, the research study was the first test of the digital platform and also the first time the participants were exposed to the tool, so at least part of what was assessed in the study was rather their response to ease of use of the tool, and not the utility and adoption of the tool itself. The platform was judged as useful but complex, and thus it can be considered as a promising tool that needs some improvement; the lack of existing tools and approaches for facilitation the organisation of open and collaborative design and making processes is a further sign of the importance of the platform. The research study provided thus to be a promising tool not just for testing the platform, but for linking it to the participants' profile and practice and to the meta-designer's (the author) practice and research. Participants pointed out the importance of the role of a technical person in facilitating the users of the platforms leads directly to the role of the meta-designer, opening here a promising direction for further research not just on the meta-design platform, but more strategically on the practice of meta-designer. The platform was considered useful but more UX/UI work is needed, and considering that the author's practice is more towards meta-design and facilitation than UX, some considerations can be elaborated. From this study a further explanation of the role of the meta-designer is emerging: a) as facilitator, b) as software developer, c) as researcher but also d) as designer of building blocks for UX designers and developers for further improving the platform. We can thus elaborate a strategy from this research not just for improving the platform itself alone, but also for improving the practice (and therefore the role and profile) of the meta-designer that develops, deploys and uses the platform. The ontology, platform and research study can be considered positively as the building blocks of a future direction of research, as building blocks for future research. Since this is a first and exploratory research, such blocks should be organised in a more coherent structure for orienting research and practice. This article argue that the framework presented by Redström (2017) for developing design theories based on both research and practice is promising in order to further structure both research and practice around the meta-design platform: from the OpenMetaDesign platform as a product, to the author's doctoral work as project, to the OpenMetaDesign conceptual framework as program, to the author's practice as meta-designer and finally to the paradigm of Open Source, Peer-to-Peer, Open and Collaborative and Meta- Design (Figure 4).

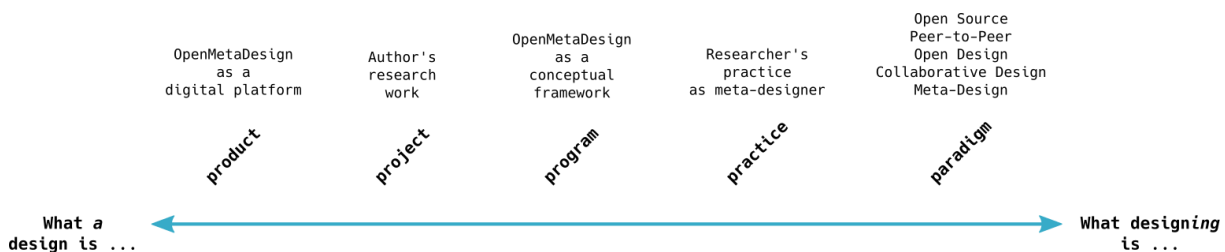


Figure 4. The RtD framework that connects meta-design research and practice

Following Redström's approach, such framework can be adopted in future research for elaborating a design theory of the meta-design practice and the role of meta-designers. This framework is thus a result from the research study: instead of just testing an improved version of the platform, this framework proposes a whole strategy for using it as the starting point for more complex work. Such RtD framework, that points to a future strategy for connecting research and practice for meta-designers (and therefore also Makers), could be also considered as one of the ways in which meta-

designers plan for their future evolution, it is the strategic and tangible version of their responsibility towards future meta-designers and designers.

5 CONCLUSIONS

This article documents a research study organised for testing a digital meta-design platform with users and the researcher as meta-designer: its results were elaborated in order to improve the platform but also for building a more organised RtD framework that connects meta-design research and practice, in order to build the foundations for further research and practice towards the definition of the role of meta-designer and of digital tools in this practice. Developing and testing a platform is useful to designers and meta-designers in developing a strategy for redefining their roles, and in the future to any designer in creating their own platform for their practice. This approach could be promising for developing future profiles for design engineering and their facilitators. More specifically, the testing of such platforms is not considered here as a way for elaborating generalised insights, but it is proposed as a future common activity for designers for redefining their own work through a mix of research and practice.

Limitations of this research can mainly be found in the fact that the version of the platform that was tested was the first one, and therefore the interface clearly needed more refinement, as the results suggests. Furthermore, only short tests with groups of two participants were possible, and future research should focus on the usage of the platform in longer activities with an action research approach with larger groups and within real practice and not tests. Future research should also focus more on both the group and individual responses and their coherence or differences. The role of the meta-designer was investigated indirectly, and future research should directly address it. The questionnaire is a research tool that can be applied again in the process of refining the meta-design platform and practice, and it should be then improved further. The UI should be simplified and improved towards a more visual organisation; along this direction, the concepts of branches/complexity or gears could be powerful metaphor for developing a simpler visualisation format based on the same (or improved) ontology. Finally, the full RtD framework elaborated here is a starting point for more structured future research which therefore should adopt and evaluate it.

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