To Make Is To Grasp

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Abstract: Making plays an important role in the design process, but the focus of design is shifting towards designing for interaction and systems. Following the changing nature of design the role of making is also under change and new tools are available. The different roles of making can be captured in a framework distinguishing 'making for exploration (inspiration/elaboration)' and 'making for validation'. The new tools accelerate the design process by accelerating the making and promise to unlock new solution domains in design but seem to deteriorate the quality of design. We argue that particularly the 'making for exploration (elaboration)' role of making is lost in the use of the new tools as they enforce more definition than is wise in the early phases of the design process promoting sketches, unfinished thoughts, to design proposals. We conclude that (1) a new craftsmanship of design is needed where the old ways of doing design meet the new ways, (2) a tool should remain a tool not become the means in itself, and (3) we need to have a experiential basis in the physical to shape the physical.

Key words: Making, The role of making, Design process, New tools, New craftsmanship of design

1. Introduction

The nature of design has changed in the last two decades. Where the emphasis was on appearance, use and mass-manufacturing of non-interactive products [19], design has turned towards interactivity [4][16] and even systems [6]. This change has repercussions on the design process and the tools that go with it [13]. Making, i.e., synthesizing activities in the design process like sketching, model making, prototyping, and such, has always played an important role in design and continues to do so. Following the changing nature of design, the nature of making is also under change. This is the topic of this paper.

We discuss the role of making in an educational setting, as we are designer-researchers in an industrial design department. Our department explicitly focuses on the design of highly interactive products, systems and related services setting it apart from other, more classic design departments. Taking lessons from how making plays a role in our department and confronting this with our personal experience with a more classic design approach we discuss the changing nature of making; we discuss the valuable opportunities that are offered by new making tools but also the side-effects that they have in the design process. We finalize with a discussion on how the old ways can meet the new ways, complementing each other, shaping the new craftsmanship of design.

2. The design process and the role of making

In this section we first present our vision on the design process as we use it in our department of industrial design after which we elaborate on the role of making in this design process, as making is one of the fundaments that distinguishes it from the traditional design process.

2.1 The design process

The act of designing is an odd one. It is an activity that operates in a continuous tension field between the necessity to make design decisions to make progress and the inherent lack of information to do so. The act of deciding forms the insights that are necessary to judge the quality of that decision; designing is a process of taking decisions based on too little information. As design—in the form that is under investigation here—is aimed at developing that which isn't yet but that which could be, and the fact that we consider design to be a holistic activity and as such inherently complex, one could even argue that a full set of decision criteria will never be more than wishful thinking. As a consequence, designers will always need to make educated guesses complementing decisions based on founded criteria.

To do so designers have access to a set of methods, techniques and tools that help shape these educated guesses and criteria. Some of these are aimed at structuring thought and reason, others at confronting abstract assumptions with the hard reality of our concrete world. Typically, these methods, techniques and tools do not exist in isolation, on the contrary: through the interplay between them, analyzing and synthesizing inform each other, making that the abstract and the concrete develop not in parallel, but thoroughly intertwined.

To summarize, we do not see the design process as a deterministic process but as an activity where you move from unspecified to specified; where we have emphasis on the added value of the reciprocity of making and thinking. We use the reflective transformative design process (RTD process) that was developed to suit the needs of the department [12], which, as stated earlier, focuses on the design of highly interactive products, systems, and related services. This process characterizes itself by non-sequential activities and reflection on action, which pivots on the acknowledgement of making as a generator of knowledge.

2.2 The different roles of making in the design process: a first framework

Building on the work of Lim et al. [15] and the efforts of categorizing prototypes and their use [9][14] we identify that making has different roles in the design process. However, we prefer the term 'making' over the term 'prototyping' because, in line with Buxton's argument that a sketch is not a prototype [3], we feel that prototypes are not to be equated with making activity in general: prototyping has the connotation of being defined, of being a figment of the mind while sketching has a more explorative connotation. The term 'making' encompasses both. We like to distinguish between (1) 'making for exploration' and (2) 'making for validation'. 'Making for exploration' has two facets: (1a) 'making for inspiration' and (1b) 'making for elaboration'. Let us briefly explain this framework of making here.

1. 'Making for exploration' is characterized by a searching nature, rather than a corroborative nature, and is twofold:

    a. '*Making for exploration (inspiration)*' is characterized by ambiguity [5][7] and a lack of predetermined planning, and is associated with ideation and conceptualization. It informs but also catalyses the decision process: it informs as a designer engages in a reflective dialogue with the material [17] and it catalyses the decision process as to explore something for example by means of a model is to bring the decision process full circle. To give an example: a designer makes sketches or simple models during ideation to explore possible solutions to a design challenge. In doing so he is in constant reflective dialogue with that what he makes, his insights form while making.

b. *'Making for exploration (elaboration)'*, is characterized by a search for detail in (aspects of) form and (interactive) behaviour. It is where the classic designerly craftsmanship blossoms. To give an example: a designer explores a radius of a fillet on an edge of a shape or he tries out different proportions of a cutaway in a solid. In doing so he is fine-tuning the expression of a design, he searches for ways to express his design intent.

2. 'Making for validation' is characterized by a directed drive for corroboration and insight. It informs the design process on the validity of decisions and has different qualities depending on what is validated. To give an example: a designer creates a well-finished presentation model or a partial model of an opening mechanism of a product. In doing so he is validating (aspects of) his design proposal: 'the looks' in the first case, the structural strength in the second case.

The distinction between 'making for exploration' and 'making for validation' is useful, as both activities are centred on making, but engage the designer differently. Yet, it is important to realize that often the making activities in a design process have both exploration and validation characteristics, as any activity in a design process remains rooted in the reality that they serve to provide direction; designers do not make aimlessly.

Next we discuss making as a catalyst for thought and then elaborate on the new tools that are becoming available for designers with the purpose of surfacing distinction issues between the act of making and the act of designing. We bring this full circle when we bring back the importance of 'making for validation' at the end of this piece.

3. Reciprocity of making and thinking: catalyzing thought

Donald Schön has made the argument that 'making' engages the designer in a reflective dialog with the material [17] and thus opens the solution domain to a given design challenge through the hands. This argument is elaborated both by Lim et al. [15] and by Hartman et al. [10] who recognize the iterative making activity, or prototyping using their terminology, as a pivotal activity for generating insight in the design process. Typically making is seen as confronting the abstract with the concrete. Some aspects of design do not make sense to make abstract, for example, those aspects pertaining to the bodily experience of a design: the feel of a button does not came across from the abstraction of a 2D CAD drawing, but needs to be felt.

This brings us to a further point in the act of making, namely that 'the perfect feel of a button' is not absolute; it depends on contextual factors, as well as a number of apparently subjective ones. This makes that a designer needs to train his 'sensitivity in buttons' through reflective practice. Richard Sennett [18] discusses this point in his book 'The Craftsman', where he puts forward that any craftsman (not to be confused with artisan) has an inherent drive to become better at his work for the sake of getting better; craftsmen have the drive to deal with ambiguity and resistance in order to improve their sense of nuance and quality, extending part of their knowledge to their hands. To bring together Schön and Sennett, the hand knows what the head doesn't but needs to be shown. Making thus acts as a catalyst of thought.

Of course we do not want to rule out the relevance of CAD practice—especially with regard to confronting the abstract with the reality of engineering and manufacturing—but the point is that any medium for exploration can only provide insights within the limits of the modality of that medium.

Yet, there is more, particularly when the design challenge gains complexity, making it virtually impossible to 'limit the solution space to the confines of your head'. Often, the more complex the design challenge, the more

design decisions tend to be interconnected in ways that are difficult to grasp and predict; requirements are not always explicit or clear and might change due to advancements in insights during the design process. A way to get grip on this is to accept that design is not (always) a deterministic activity and that the proof of the pudding is in the eating. In other words, making for exploration provides grip on the design challenge in complex situations because it engages your gut feeling (your intuition) but also let's you test it because a prototype allows for validation by experiencing, it brings the decision process full circle and lets you experience the designers rationale [11].

Which brings us to the following: when designing for interactivity and further it does not suffice to sketch or to make static models. Instead, it is essential to engage in the temporal aspects of interactivity.

4. The changing discipline

The design discipline is changing. Running the risk of over-generalizing, the emphasis within design has shifted from form to interaction and is currently shifting towards (social) systems. The design department that the authors are associated with is an example of this shift in emphasis and we like to shed light on how this has repercussions on the design discipline.

The shift towards 'designing for interaction' and concurrently 'designing for (social) systems' changes the design challenge. When designing for interaction, aspects of temporality and behaviour are added to the classic design challenge, making it bigger and thus more complex. This has resulted in a difference in design approach and tools.

To 'battle' complexity there is more emphasis on experienceability [2][4] in the design process. That is to say, to experience, through a (lo-fi) prototype, the impact of a design decision makes it possible to judge the impact; it reliefs the designer of having to juggle everything in his mind. The reason why this is getting more important when designing for interaction is because the temporal aspects of interaction design, the action reaction loop, is difficult to predict, particularly when the interactions are becoming complex. Systemic aspects like interconnectedness, distribution and social structures add even more layers of complexity to the design challenge, amplifying the need for experiential approaches.

The other side of this argument deals with a difference in tools. The design discipline borrows from other disciplines than before after the shift from form to interaction. Roughly speaking, classic design can be positioned in between art-school and mechanical engineering while design for interaction can be positioned between art-school and electrical engineering and computer science. From these disciplines it borrows skills, knowledge, methods and tools.

While we envisioned that the classic design skills would meet the new skills when the emphasis shifted from form to interaction and (social) systems [6] this seems not necessarily be the case. The new tools and skills appear to be heady material that replaced, rather than augmented, the classic design tools and skills. Involuntarily helped by the emphasis on experienceability in the design process, we observe that the distinction between making and designing has disappeared. In the next section we discuss this phenomenon.

5. New tools and technologies: accelerating the design process or cutting corners?

With the advent of new tools that can be used to inform the design process, designers have more power than ever before. The making process has been accelerated to a great extent allowing us to make things that even ten years ago were beyond our wildest dreams. These new tools extend both into the domain of creating 'working prototypes' in order to make for exploring and validating interaction (e.g., Arduino [1], Phidgets [8], Gadgeteer [20]) but also into the domain of form (e.g., laser cutting, 3D milling, 3D printing) where the question remains if this making activity is just of validating nature or also of explorative nature.

On the one hand the possibilities these new tools create are great as they potentially bring a designer much closer to the market in earlier phases of the design process, on the other hand they are not so great as they seem to blur the boundary between making (as in: prototyping) and manufacturing. This is an interesting but sometimes-unwanted side effect, as the act of making starts being confused with the act of designing. These two points deserve elaboration.

The new tools give us access to new ways of exploring and validating interaction and form; they open up a new solution domain and even a new aesthetic. Being able to explore and validate aspects of interactivity by means of for example an Arduino board [1] or Phidgets [8] makes it possible to add detail and expressivity to the behaviour of interactive products that was difficult or even impossible before. And this goes for form as well, the use of laser-cutter and 3D printer makes it possible to for example make series of artefacts to explore and validate for example behaviour of distributed phenomena in design while the speed and low cost makes these insights accessible even to design students. This makes that the increased accessibility of new 'making' tools such as rapid prototyping (3D printing and laser cutting) or video-editing software provides a stage for new 'thinking'.

The other side of the argument concerns the side-effects of the new tools. We have access to prototyping tools that allow us to conceptualize aspects of design that we could not before, such as interactivity, straight from the early phases of the design process. This results in interactive, experiential prototypes that are functional and are thus often not perceived as the sketches that they are but as full-fledged design proposals. Yet, they lack the nuance and quality in detail that was the standard of before. The lure of making things work seems to be stronger than the need to engage in the act of designing. This is a pity as we feel that there is something lost at both sides of the 'equation': the immense potential of the new tools—following our earlier argumentation about reciprocity of making and thinking means that new tools will catalyse new thoughts—is not becoming reality because it lacks the finesse and quality that is embodied in the classic design skills, particularly in 'making for exploration (elaboration)'. We are left with 'product proposals' that thoughtlessly adopt the aesthetic of the machine rather than the aesthetic of craftsmanship. This does not mean that we reject the aesthetic of the machine, but rather that we observe that the perspective to make the distinction between the two is often missing.

We attribute this phenomenon to the following. In a classic design process, typically, the tools we use have the same fidelity as the insights that we need. While the design process develops from lo-fi explorative artefacts to hi-fi validating artefacts, the insight in the solution domain progresses concurrently from a state of high ambiguity to one of high definition. For example, a lo-fi sketch explores the quality of a form while a hi-fi CAD model defines the geometry of the form. This means that tools in earlier, exploratory phases provide overview rather than definition.

However, what we see occurring is that many of the aforementioned tools have made that the fidelity of the prototypes that are created is much higher than that of the knowledge that is sought—or available for that matter. We feel that the reason for this is two-fold. On the one hand many of these new tools require defined input that can only be given through software interfaces that (1) disconnect that which is made from the medium through which it will be experienced, and (2) requires the maker to define in too early phases. On the other hand, the results of these tools, the physical models that come out, are not interpreted as 'sketches' but as ready-for-market designs. Due to the apparent realness of the resulting artefact, plus the investment in time and energy to 'make it work', the artefact is often taken as a decision in itself, rather than as a step towards a decision; the model is judged as a finished product rather than as a creator of insights. As such these tools seem to force the designer to cut corners, reducing activities that are essential in creating the overview to make these definitive design decisions.

The craftsmanship of design, the detailing, the feel for form and even the sense of quality suffer from the acceleration of the design process by the new tools that are available. Paradoxically the tools that should empower the act of making result in poorly crafted design proposals. The shortcut in the design process seems to stunt the act of designing and 'making for exploration (elaboration)'.

6. Concluding

6.1 We argue for a new craftsmanship

The new making tools that have entered design practice seem to 'counteract' the power of making and the craftsmanship in design. On the one hand making is accelerated in extreme ways, but it is getting confused with designing and thus it is getting disjunct from design. This is problematic as this stands in the way of quality. While the new tools afford new thoughts, these thoughts will not blossom when the interactive sketches, the physical ideas, are promoted to design proposals. These prototypes, that are the result of the new making, often lack the finesse that is expected from a design that is to enter the market. As we see this happening in our own school we want to reemphasize the importance of 'making for exploration' and 'making for validating' focusing not only on validating the concept but especially also how the concept meets our senses. Particularly 'making for exploration (elaboration)', seems to suffer from the use of the new tools as the need to define form shortcuts the need to detail form. Therefore we consider 'Making for exploration' and 'making for validation' to be equally important. This means that the artefacts that are generated through the new tools need to be considered in terms of the insights that were sought and not in terms of the definitiveness that they express. They are unfinished thoughts and need elaboration. Such an artefact starts a further exploration in elaboration. This is not to say that we take a Luddite stance: we strongly feel that the new tools provide new inroads to the solution domain and thus catalyse new thought. We therefore argue that the new ways need to meet the old ways and not supplant them. We argue that a new craftsmanship of design is needed where we have a rich portfolio of skills affording a rich set of access points into the solution domains of our complex design challenges.

6.2 We argue that the tool is a tool and not a means in itself.

The important thing to remember is that making and thinking flourish only in reciprocity, mediated by (and serving) a common goal: getting to a design. More often than desired we observe that the means take over the goals, resulting in a 'prototype with a good story' rather than in a 'design that physicalizes its rationale'. We believe this is due to the abstract and the concrete acting in isolation, rather than in harmony. Concrete walls that

fit like a glove in CAD are still subjected to climatic effects at the construction site. Hence, the story and the prototype need to be one, explored and validated through making.

6.3 We argue that making does not equal designing

Finally we wish to state that making is an important part of design, but does not equal it. When high-quality printers were introduced, people announced the end of the graphical industry, as the proper tools were now available to the masses. Over the years it has become painfully obvious that this was a fallacy, graphical design thrives. The tools that afforded everybody to make, did not automatically granted the dilettante designerly skills. It is notable, however, that the graphical industry has embedded their new tools firmly in their practice and has become more powerful and creative because of it. This has yet to happen in industrial design.

As designers we value making; it is crucial to designing and it is hard to overestimate its power. Paradoxically, the new tools that empower the maker have an adverse effect on the designer, as the new making tools seem to sacrifice craftsmanship. The shortcut that the tools afford is a great way to reach more depth in a design project as it allows for more exploration but should not be used to cut corners. While our current observations on the side-effects of the new making tools in design might be caused by the novelty of the tools and the mismatch of their operation with the early, ambiguous phase of the design process but we feel that if a designer has not met the physical he cannot shape it. We need to build a base of experience before we create the shortcut. Famous painters such as Picasso or Mondriaan were excellent figurative painters, although they achieved most fame with their abstract work.

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