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DoDesign: A Tool for Creativity-based Innovation

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Abstract. This paper describes the results of a pilot project set up to develop the concept behind DoDesign. DoDesign is a design tool and platform aimed at stimulating designers towards innovative designs (as contrasted with 'routine designs'; see Dym, 1994) and thereby stimulating new economic activities in the corporate sector (innovation). DoDesign combines the knowledge of designers and companies with regard to materials and processing techniques. This knowledge is structured and diffused in ways that are innate to both groups. The concept and structure of DoDesign has been developed on the basis of a theoretical study and tested in the contexts of a number of focusgroups and workshops. Finally, the working of DoDesign as a network between designers and companies is explained and illustrated using some design cases.

Keywords: Creativity, design tool, innovation, designers, companies.

1 Introduction

In order to stimulate innovation, policy makers do not simply provide finance for companies to generate new ideas. They prefer to stimulate companies to keep an eye on the respective institutions conducting fundamental research and to select those ideas that have economical potential in the context of their activities. It is only when a relevant business case is selected that funds for stimulating innovation are made available to these companies (IWT, 2010). This process could be called **bottom-up innovation**. It ensures that innovation and new, good ideas emerge without external guidance. In this sense, it is comparable with the process of natural selection in which innovation evolves by the selection of good solutions (Cziko, 1995) without someone explicitly guiding this process.

Always experimenting with (new) materials and processing techniques, designers play an essential role in such bottom-up innovation. In order to understand this role, a distinction should be made between two prototypical kinds of designers: 'industrial designers' and 'artistic designers'. In this paper, these two kinds of prototypical designers are defined as follows: **Industrial designers**, who spend most of their time designing for big companies, are asked to design objects (products or subparts of objects) starting from an elaborate list of specifications according to a predefined function (Roozenburg & Eekels, 2003). Inconsequently, the choice of materials and processing techniques is highly predetermined by the design task itself. The **artistic designer**, on the other hand, does not necessarily start from a list of functional specifications (Hayon, cited in Bucquoye & Van Den Storm, 2008) and is thus free to choose from materials and processing techniques without these being predetermined by the design task (Coles, 2005; 2007). Of course, these two kinds of designers are only two extreme positions on a continuum. Some designers may be more positioned towards the industrial end and others more towards the artistic end.

The design process of both kinds of prototypical designers is different (this diversity in design processes was observed in several of our focus groups). As a consequence, the potential of their results with regard to the bottom-up kind of innovation described above is also different. Because of the artistic designer's **out-of-the-box thinking** and tendency to experiment with innovative combinations of existing materials and processing techniques, these designers tend to find new solutions that are not usually found in the sector in question (Brown, 2009).

Because of this difference in the design strategies of both kinds of designers, both processes require different kinds of information. When looking at the design support tools developed today, there is a strong emphasis on tools for industrial designers. These tools (e.g., CES, Granta Design) are very useful when starting from a set of functional specifications, automatically suggesting a range of materials and processing techniques that are best adapted to the functional specifications at hand. For the more artistically oriented designers, these tools are not always adequate because the search process becomes constrained by a set of predetermined solutions. A design tool, set up for stimulating bottom-up innovation, should incorporate a search module based on the natural search process of these artistic designers (see 2.1). **DoDesign** is such a tool/platform for stimulating innovation based on the creative activities of artistic designers (creativity-based innovation).

The general workings of DoDesign can be described using figure 1. In this figure, artistic designers create objects by combining materials and processing techniques in implementing their concepts, functions and/or ideas. Their design activities are conducted outside the corporate sphere but for the actual implementation of their design (the actual materialization) they seek an active collaboration with specific companies. After all, they need the right materials, processing techniques and production companies that are willing to produce and distribute their designs. The corporate sector, on the other hand, consists of material engineering companies, material processing companies and those companies that effectively connect the activities of both. These companies are potentially interested in the ideas generated by artistic designers, hence the close interaction between both groups. DoDesign aims to gather and structure information from both sides of the fence, and make it accessible to both in order to stimulate **creativity-based innovation**.

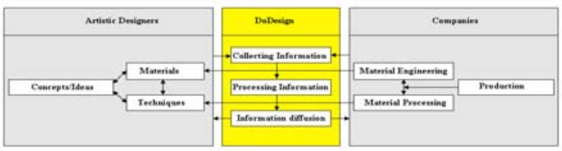

Fig. 1. DoDesign as a facilitator of interaction between artistic designers and companies

2 Development of DoDesign

2.1 Concept

In order to develop a tool to support artistic designers, a literature search was first conducted in the field of existing design models (e.g., Alexander, 1964; Cross, 2006; Dorst, 1997; Gedenryd, 1998; Lawson, 2006; Schön, 1991; Simon, 1967) and the application of these models in concrete design tools (e.g., Material Connexion, Materio, …). The results of this theoretical overview were combined with the results of a number of focus group discussions with expert designers. For this study, three focus groups (a total of 24 designers) were organized in order to study the diversity in design processes among different designers. These two sources of information (literature and focusgroups) provided a rather complete picture of the natural design process in daily practice.

This resulted in an explicit **design language**, which is the basis for the structural development of the design tool, DoDesign. The extensive and complete description of the developed design language is described in Wuytens & Willems (2009). In what remains, only the concepts essential for the development of DoDesign are described and illustrated with some quotes from the focus groups (shown in italics).

To design an object (e.g., furniture, jewellery, utensils, ceramic vessels, art, …) designers, consciously or unconsciously, take a wide range of factors into consideration. These factors are called **parameters** in design jargon. These parameters can have different values and designing an object is, in a rather abstract way, viewed as giving concrete values to these parameters (i.e., adding **constraints**). For example, the colour of the material used for a specific object is a parameter with different possible values (e.g., white, yellow, red, blue, ...). When deciding to use a blue material for this object, this concretized parameter (colour = blue) is called a constraint.

Designer: "I see the process of designing as a whole process, ... The product is important, the material, the weight, the price, the package, the presentation, ... These are all decisions that have to be made."

Because each object can be defined by reference to a huge number of parameters, each designer has his/her own individual way of grouping these parameters into meaningful wholes, called **clusters**. Even different design tasks can require different ways of clustering the relevant parameters. For example, relevant clusters in the context of jewellery design are Material (with parameters like, for example, hardness, colour, transparency, melting point, ...), Technique, Form and Function.

Designing is not a linear and sequential process going from an analysis of the problem toward potential solutions (Rittel & Webber, 1973). Constant reflection is a necessary part of the design process (Schön, 1991) and each consideration of a parameter can be described as a reflective moment where the designer checks whether a particular choice of a parameter matches previous constraints (looking backwards) and whether this parameter could lead to a desired output (looking forwards). In the design language, this process is called **design parameter reflection.** If a particular choice does not fit one's expectations, one or more constraints are reconsidered (called **backtracking**). Because the order in which the parameters are considered depends on the designer (and the specific design task), and because there is a constant backtracking to previously made choices (i.e., constraints), the design process is described as an individual and highly non-linear process (Wuytens & Willems, 2009). The following quote describes this non-linear search by backtracking to the constraints concerning the material:

Moderator: "So you only realized the design because you found the right material?"

Designer: "Yes, I was working in a variety of materials, plasticine and things like that, but it was not what I expected and suddenly there was glass and that was different, it has the right feeling, the emotional feeling that I wanted to achieve."

Both the order in which the parameters are considered and the way these parameters are clustered in meaningful wholes is dependent on the designer and the specific task, so both contribute to the diversity that is apparent in between different designers. Where the industrial designer, as described above, usually starts with a specific function for a design (a set of functional specifications), an artistic designer, on the other hand, gives a central position to other clusters as well like the material to be used, the technique, the shape, …. The following quotes illustrate this diversity with regard to the order of clusters to be considered:

*Designer: "I'm a practical guy, I try to design things that can be used, which are strong/solid and good when they are being used. That is the first condition. If they do not work well, I don't like them." (**Function** as a starting cluster)*

*Designer: "I always work with plastic and see what I can do with it." (**Material** as a starting cluster)*

*Designer: "I'm always starting from the material itself. Clay. With clay all shapes are possible, ... " (**Material** as a starting cluster)*

*Designer: "My inspiration is always the nature and the human being. That is my starting point for searching the right shapes. I try to make these forms/shapes always monumental, I try to make them timeless and aesthetic." (**Shape** as a starting cluster)*

*Designer: "Normally, if you design jewellery, you use traditional techniques like sawing, filing, stone setting, ... I wanted to induce a new kind of design without using these traditional techniques. For this design, there was no sawing, no filing, no soldering, ... In this design I wanted to visualize this process of forcing metal, by making a ring out of one thread, explicitly. The process or the technique determines the design." (**Technique** as a central part of the concept)*

2.2 Implementation

The act of choosing a parameter or a cluster, the imposition of constraints by assigning a value to a parameter, continuously reflecting on choices and the ability to backtrack (see 2.1), all form the basis for the structure underlying DoDesign. This structure was also tested in several workshops with a diverse group of 10 artistic designers (studio jewellers, interior designers, product designers, …). Because DoDesign wants to support the choice of materials and processing techniques, these two items are the main clusters in the tool (figure 2). Both clusters are also related to each other, which makes it, at any time, possible to see what materials can be processed using specific techniques and vice versa. In addition, DoDesign also offers the possibility to search a third cluster of existing design cases (experimental links between materials and processing techniques or products/objects that are already in production). Here again, links to the other two clusters are provided (these design cases are made of particular materials using some processing techniques). Due to the links between materials, processing techniques and design cases, DoDesign offers a diversity in search strategies. This diversity in search strategies within DoDesign is needed because of the diversity in design strategies of artistic designers (as observed in the focusgroups).

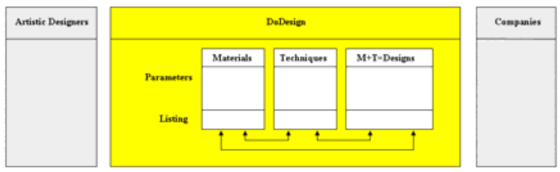

Fig. 2. DoDesign as a source of information with regard to materials, processing techniques and design cases

In order to illustrate the diversity in design strategies DoDesign can support, some fictitious cases will be given. When considering the choice of a particular material, a first way to use DoDesign is by specifying the physical, ecological and/or economic characteristics (within DoDesign all examples of possible parameters) of the material needed for the design. In this way a material can be found by filtering the list of materials available within DoDesign (Fictitious Case 1).

Fictitious Case 1: A designer is looking for a metal (traditional material parameter), with a gray colour (physical material parameter), with a price below 5€/kg (economic material parameter), available within the region of his workplace (ecological material parameter), and with a rather cold expression (subjective material parameter). Finally the designer ends up with the material, aluminium.

Another way to search for a material is by choosing directly from the alphabetical list of available materials. Here, too, it is possible to order this list based on the same parameters used as filters in the preceding design case (Fictitious Case 2).

Fictitious Case 2: A designer, ordering the listing of materials by means of the parameter colour (physical material parameter), discovers that gold appears in several colours (red, blue, white, green, ...) and not just traditional yellow. The designer is therefore guided towards unexpected and new choices.

In this way, a simple list, ordered in specific ways, can stimulate innovation and the use of unexpected materials. Both ways of searching are constrained to a specific cluster (Material in this case). Therefore they can be called a **within-cluster-search**. Another way of searching for a material is to use elements of the other two clusters (technique and design cases) to filter and search for a material. In these cases, the links between the different clusters are used. Therefore these ways of searching can be called a **between-cluster-search**. A first illustration within the range of possible between-cluster-searches is by filtering the listing of available materials by selecting a processing technique (Fictitious Case 3).

Fictitious Case 3: A designer selects all the materials that can be processed using the technique of drilling.

Another possibility is by selecting a group of materials by means of a within-cluster-search within the cluster of techniques (Fictitious case 4).

Fictitious Case 4: A designer is looking for a material that can change in shape while being processed (traditional technique parameter), and with a smooth texture after being processed (physical-appearance technique parameter). The designer has a positive and a negative mould (moulds technique parameter), ... Finally the designer ends up with the group of materials called thermoplasts (composites).

Another possibility is choosing a material by means of the cluster of design cases (between-cluster-search, Fictitious Case 5).

Fictitious Case 5: A designer is strolling through the list of design cases without having anything specific in mind. There, he finds a design case made of very interesting materials (which he can select for further study using the link between the clusters).

Again, a between-cluster-search can be combined with a within-cluster-search (as in fictitious case 4). In this case the parameters used for representing the design cases can be used in order to select a group of materials (Fictitious Case 6).

Fictitious Case 6: A designer is looking for a material that tends to be used in products that have interesting ecological properties. Therefore the designer selects design cases that are already in production (status design case parameter) and that have a small ecological footprint (ecological design case parameter). Via the link between the cluster of design cases and the cluster of materials, the designer ends up with the group of materials that tend to be used in ecological designs.

Of course, these six different ways of looking for a material can be applied when searching a processing technique or a specific design case (both within- and between-cluster-searches) resulting in a total of 18 different search strategies. When an individual element is selected (a material, a processing technique or a design case), more information is available for each element. For **materials and processing techniques** a technical file is available with additional information (publications, websites, information demos, links to other related materials or techniques, …) and companies (contact information, products, materials and processing techniques available, …).

With regard to this last point (materials and processing techniques available), additional information is provided with regard to the accessibility of these companies for artistic designers. Some companies do not process items below a minimum number of pieces and within some companies it is not possible to buy small quantities of a certain material. Of course, this kind of information is of great importance for designers when experimenting with materials and processing techniques.

For the **design cases** a technical file is also included with information about the design case (designer, production company if in production, …). Based on this information, it is possible for designers to contact other designers that have experience working with certain materials and/or processing techniques. In the same way, production companies can contact designers attached to the design cases that seem interesting to implement in their company but or not yet in production.

A whole range of search strategies are therefore possible, based on either: a) the parameterized representations contained within the clusters Material, Technique and Design Cases; b) the link between elements of these clusters; and/or c) the additional information stored at the level of these individual elements (materials, techniques and design cases). A last fictitious case illustrates some of the possibilities when combining different search strategies and different information from three clusters in specific ways (Fictitious Case 7).

Fictitious Case 7: A designer finds a design case by designer X (cluster of design cases), and is able to select the material used for this design case (cluster of materials). When studying the technical information about this material, the designer notices that the material is not waterproof which makes it not suitable for the application (a garden table). The designer is interested in all the other properties of the same material and thus searches the material cluster for other materials with the same properties but with the additional constraint of being waterproof. Perhaps the material also has to be thermoformed, because the designer is used to working with this technique (cluster of techniques as a filter for materials). Finally, the designer ends up with EVA (Ethyleenvinylacetaat). Via the information links attached to this material, the designer finds some companies that are willing to sell this material in small enough quantities and via the link to the design cases the designer can contact another designer that has carried out thermoforming of EVA before.

DoDesign's support for this diversity in design strategies is important. It stimulates the out-of-the-box thinking of artistic designers resulting in interesting new ideas. In order to see how the development of new ideas in the context of DoDesign can stimulate creativity-based innovation, it is important to explain DoDesign's platform function, linking the activities of designers and companies.

3 Creativity-based Innovation

In the introduction, DoDesign was generally described as a platform, collecting information, structuring it in relevant ways and diffusing it back to these designers and companies (figure 1). Based on the structure of the database on which DoDesign is based (figure 2), it is now possible to describe this flow of information in more detail (figure 3). The first kind of information that DoDesign collects is the knowledge of companies with regard to materials, processing techniques and design. The second kind of information that DoDesign collects is the information regarding the different design cases of designers that are not yet in production.

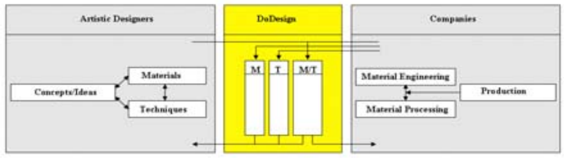

Fig. 3. DoDesign as a platform for structuring the information flow between artistic designers and companies

This information, collected from companies and designers, is structured in relevant ways. At the moment, within the pilot version of DoDesign, the structure of the underlying database, the interface and part of the content have already been developed. Tree cases are described in order to give an idea of what kind of activities DoDesign could support. These cases were already realized before the development but illustrate how the tool could be used.

A first design case describes how designers can be linked to the right companies (Design Case 1, figure 4).

Design Case 1: a designer developed a prototype of a chair but could not find the right processing technique in the sector of interior design. Therefore he decided to look for the right processing technique in a different sector (automotive) and found it, resulting in a chair that could be produced.

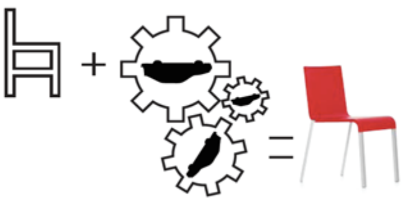

Fig. 4. Design Case 1 (Maarten Van Severen)

The following design case describes the out-of-the-box-thinking of designers and the way the experimental activities of designers can result in new ideas worth implementing in production companies (Design Case 2, figure 5).

Design Case 2: a designer knows the technique of milling and he uses this technique frequently in his designs (bowls, vases), made wood. Based on DoDesign, this designer could have looked for other material possibilities that could be shaped by this technique. Thanks to DoDesign, the designer notices the material paper. This material cannot be milled under normal circumstances, because it is too flexible, but by processing it in a special way (pressing and bonding), this material can be milled (innovative link material and technique). An additional advantage is that this material can be used in waterproof applications. The designer chooses to mill the shape of a vase, a design with an unusual material for this feature.

Fig. 5. Design Case 2 (Thomás Gbazdil, Studio Libertiny)

The final design case (Design Case 3, figure 6) shows that all kinds of companies (material engineering/processing or production companies) can benefit by searching DoDesign. It supports companies to find the right designer/designs that fit the company's vision.

Design Case 3: A furniture company is looking for some coffee tables that would match their collection of chairs. By using DoDesign, they find a designer whose design matches their style. This designer has designed a coffee table that is not yet in production. The company can almost produce the table with the techniques they have available (milling, sawing, ...). However, the company has no machinery for thermoforming (technology that is part of the design). With the aid of DoDesign, the company can search for a thermo-forming company capable of producing the table in collaboration. In this case, DoDesign could have been used to search for both designers and companies.

Fig. 6. Design Case 3 (Karen Wuytens)

4 Conclusion

The citations and design cases discussed within this paper illustrate the concept behind DoDesign and the ways in which it can be used as a tool for stimulating out-of-the-box thinking amongst artistic designers and innovation in the corporate sphere. DoDesign's specific structure is developed according to the natural design process of artistic designers. For this reason, it can offer sgnificant support for a diverse range of design strategies.

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