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PHOTOGRAPHY - A NEW TOOL IN NEEDFINDING

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Abstract

In this paper we are proposing the use of photography as a dedicated tool to capture latent needs and create anchor points for future solutions in engineering design. We are grounded in user centric design. Based on a needfinding project in India we demonstrate the usage of sequential photography techniques to identify and propose needs through priming the viewer into modes of divergent and convergent thinking. We have selected 49 out of a total of 381 pictures taken in October 2014. These pictures have been processed to our three types: snapshot, emphasized picture, and illustrated picture. Each technique and usage is described in detail, together comprising a proposed new method for needfinding.

Keywords: Needfinding, Design methods, Early design phases, Photography

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1 INTRODUCTION

Conveying information gained through needfinding to third parties always contain a strong element of bias. We propose to consciously use altered pictures to convey information and to initiate divergent or convergent iteration processes. Through this we propose the use of photography as a tool in needfinding.

Our intent is to support the needfinding in engineering design projects by generating complementary data and stimuli in the early phases of the iterative user centred engineering design process (Leifer and Steinert, 2011). User-centred design (Norman and Draper, 1986) has emerged since the 1950ies and is supported beyond design as core concept of understanding the deeper/hidden needs of the user (or any other stakeholder for that matter). In the 1980ies Robert McKim, Rolf Faste and David Kelley from the Stanford joint product design program coined the term “needfinding” and introduced a method to identify unmet and often untold needs (Patnaik and Becker, 1999). It has since become a corner stone in the general engineering design process (Eppinger and Ulrich, 1995). Its key method especially concerning the subliminal needs is observation. Generally the in situ observation studies on the tradition of ethnography and anthropology are favoured. However esp. retrospective data analysis is central as the observer is usually not able to catch all data in real time. The true needs and the “nuggets” a future product could be build upon are generally latent or hidden (Aldaz et al., 2013). Observation “can produce unadulterated, direct and potentially very rich descriptions of events and their context, because data is captured while the phenomena occur” (Blessing and Chakrabarti, 2009). However esp. retrospective data analysis is central, as the observer is usually not able to catch all data in real time (Patton, 2002). Steinert et al. (2012) include Alexander’s idea of divergent and convergent thinking in their model, combining it with a series of design-build-test cycles as described by Thomke and Fujimoto (2000). As can be seen from Figure 1, they have made a model that shows how the process is gradually converging towards a final solution after running through several phases of diverging and converging iteration cycles.

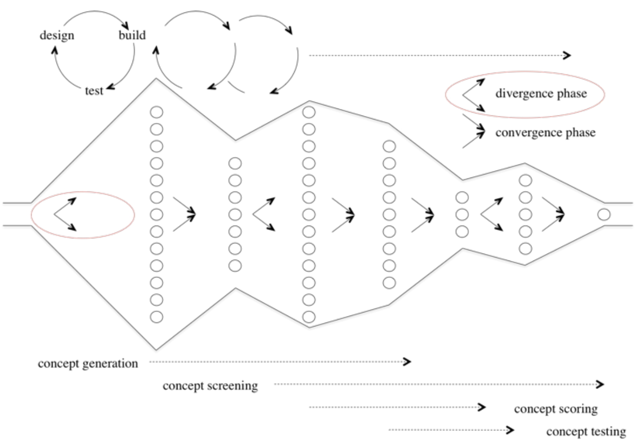

Figure 1: Divergent/convergent, iterative process. (Steinert et al., 2012)

2 NEEDFINDING

The overall goal of needfinding in an engineering design project is creating a solid foundation to build a product or service on. Of central importance at the early stage of a new product or system design, is the clear understanding of first, who the actual user is and second, of which user needs have to be covered by the new design solution (Steinert and Leifer, 2012). Needfinding is the discipline of perceiving exactly these user needs (Faste, 1987). What is it that the user needs to do? It is important to be clear on what a need is. Faste (1987) describes a need as a perceived lack, something that is missing. A product built on a clearly defined need is much stronger than a product made because it was technologically feasible to do so (Faste, 1987). This is because a product anchored by a real need is something that the customer wants, and should therefore have a market.

As Steinert and Leifer (2012) describe with their Hunter-Gatherer model, the path of any development project is seldom a straight line, but rather a series of shorter sprints steering the direction of the project along the way. We adapt this way of thinking to the needfinding process, zooming in, and treating the final need statement as the goal of the hunt! Figure 2 depicts two different engineering design processes. Figure 2a shows us the incremental, "classical" engineering design process. It is fixed target design, specifications and requirements based. With other words, the boundaries are defined in the beginning, and these shape the process. The engineering design team is moving towards the goal, adapting their solution to the specified requirements. Figure 2b is the radical engineering design process, adapting the constantly evolving boundaries described by Steinert and Leifer (2012) in their Hunter-Gatherer model. The figure shows there are multiple paths available, and depending on where the design team decides to go, the boundaries change accordingly.

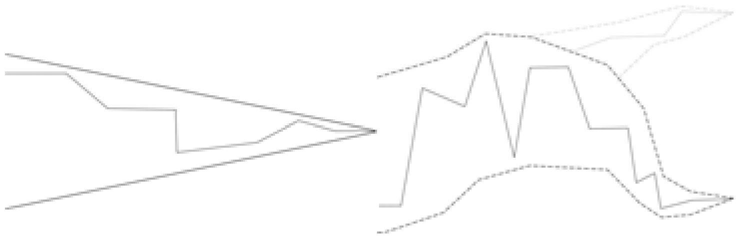

Figure 2a & b: a) Incremental engineering design process – adaptive in style. b) Radical engineering design process – innovative in style. (Steinert et al., 2012)

When doing needfinding, we have several tools at our disposal (Patnaik and Becker, 1999). Some of them enable us to experience needs and pains for ourselves, while some tools provide us with the experience of other people. We differentiate the tools into *unbiased*, what we experience directly, and *biased*, second-hand information. Among unbiased tools we find: observation, immersion and taking existing products apart. These tools are free from the interpretations and filtering of others. Biased tools are: video, storytelling, interviews, pictures and sketching to mention some. All of these have in common that they are a product of the needfinder's interpretation. Someone had to make a choice of what to communicate through their video, or what to tell when they were interviewed.
The biased needfinding tools allow us to control information provided, and through this we believe that it is possible to steer the attention of the designer and thereby have some control over the direction of the output. This is what we call priming or design fixation (Cardoso et al., 2009; Purcell and Gero, 1996).

Needfinding insight 1: By using biased needfinding tools, we are able to influence the needfinding process (by controlling attention)

There are mainly three aspects in the biased needfinding tools we can influence:

- The amount of information (how much)
- Selection information (what do we present)
- Emphasis on parts of the information (how it is communicated)

In this paper we will focus on the use of pictures in needfinding. We want to use pictures to firstly prime the design team with the content of the pictures, and secondly to capture results from team discussion in a visual manner through the team's selection and post-processing of pictures. Using photography as a research tool in an engineering design application, draws inspiration from the field of visual anthropology, learning how to observe and document findings (Collier, 1986). In his book, Collier (1986) describes the unbiased selection of information made by the camera. "The camera, by its optical character, has whole vision. No matter how select a unit we might wish to photograph, the camera faithfully records this specialized subject and also all other associated elements within focus and scope of its lens. This capacity makes the camera a valuable tool for the observer." In addition to capturing the intended subject, there will always be additional contextual information in the picture frame, making the picture a much richer source of information than text. Text has the ability to only provide information of the intended subject, removing all superfluous information. The extra associated elements of the subject within focus and scope of the camera lens previously described by Collier are beneficial for needfinding, as the process is about creating an understanding for the situation where needs are to be found. This lets the viewer of the picture immerse himself in the situation depicted, based on the context supplied by background information in the picture frame. Collier pointing out the unbiased selection of information made by the camera is somewhat a paradox. Yes, the information captured within the focus and scope of the lens is to some extent unbiased, we will discuss later in the text how certain techniques can steer the focus of the viewer. On the other hand, a picture only captures an instantaneous moment in time, and only a small portion of the photographer's surroundings. Overall the picture is a biased representation of reality, allowing us to control the perception of the viewer.

We know that pictures are widely used in needfinding exercises already. What has not been discussed previously is how different pictures may influence the thought process of the designer viewing them. Would it be possible to steer the needfinding process by using certain types of pictures?

Needfinding insight 2: By using certain types of pictures, it is possible to induce specific behaviours in the designer doing needfinding.

3 PHOTOGRAPHY

As a photographer, we have defined four main parameters that can be controlled without any major influence of the situation to be documented. These are depth of field, focal length, contrasts and framing. In this section, we give a brief introduction of each variable, and how it should influence the viewer.

3.1 Depth of field

Depth of field signifies how much of the picture will appear to be in sharp focus (Pentland, 1987). An object is in focus when light rays reflected of this object converge in a single point on the image sensor of the camera. Out-of-focus objects hit the image sensor in circles instead of converging to a point. These circles are termed "circles of confusion". When the circle of confusion becomes small enough to be indistinguishable from a point object in the final image, this point in space is considered to be in focus (Jenkinson, 2011, p. 38). A shallow depth of field means that there is only a small portion of the frame, close to the focal plane that will be in sharp focus. How much an object is blurred increases with the distance from the focal plane. A large depth of field results in a larger portion of the frame in focus. Depth of field is closely connected to the effective aperture of the camera. The aperture is the opening where light is let in to expose the film or sensor. The effective aperture of a lens is calculated by dividing the size of the lens opening d by the focal length f (Equation 1). Effective aperture is described by f-stops, so a 25mm lens opening divided by a focal length of 50mm results in the f-stop f/2 (Jenkinson, 2011). The lens f-number N is the denominator of the fraction describing the f-stop, *f/N*. The size of the aperture is inverse proportional to the depth of field i.e. a large aperture (big opening) results in a shallow depth of field. A small aperture (small opening) results in a larger depth of field. The reason for this is that rays of light that passes through a small aperture are more parallel and will result in smaller circles of confusion than when passing through a larger aperture.

$$f/N = \frac{d}{f}$$

Equation 1: Lens f-stop (Conrad, 2015, p. 5)

Total depth of field u_{total} can be calculated by Equation 2 from the focusing distance u, f-number N, focal length f and a predefined acceptable circle of confusion c, usually between 0.025mm and 0.035mm for full-frame image sensors. With constant magnification, focal length does not have any significant impact on the total depth of field. This means that we can assume depth of field is only dependent on effective aperture for constant magnification.

$$u_{total} = \frac{2uNcf^2(u-f)}{f^4 - N^2c^2(u-f)^2}$$

Equation 2: Total DoF (Conrad, 2015, p. 8)

We predict that depth of field will control the amount of information the viewer is able to extract from a picture. The eyes will be attracted towards objects in sharp focus, creating more emphasis on these. Out of focus objects are uncomfortable to watch, and is implicitly interpreted as unimportant by the viewer since the photographer has chosen to leave these objects out of focus. By using a large depth of field, we hope to spread the attention of the viewer throughout the picture, not giving emphasis to any specific region. A shallow depth of field will on the other hand steer the viewer's attention to the limited region in sharp focus.

3.2 Focal length

Focal length is a measure of the distance between the lens and the image sensor in the camera to focus sharply at infinity, i.e. objects far away (Jenkinson, 2011, p. 42). Different focal lengths give different effects in both angle of view and distance on perspective (Jenkinson, 2011). Lenses with short focal lengths are called wide-angle lenses, and lenses with a long focal length are called telephoto lenses. Wide-angle lenses can be used to include large portions of background, including the subject in a context, while telephoto lenses can be used to isolate subjects.

Changing focal length touches two aspects of how we can steer the viewer's attention. *First*, by changing focal length, we achieve different angles of view (Jenkinson, 2011). This influences the amount of background included in the picture, and thus the amount of contextual information captured. Due to this effect we predict that a shorter focal length (larger angle of view) will keep the attention of the viewer wandering, resulting in broader ideas and insights. Reversely, a longer focal length (narrower angle of view) will keep the viewer's attention more focused on the main subject. *Second*, the perspective of depth changes with focal length (Jenkinson, 2011). For shorter focal lengths, relative distances between objects in the depth-direction in the picture appear to increase. We call this *stretching*. Longer focal lengths create the opposite effect, called *compression*. This makes all objects appear to be closer to each other, and thus more similar in size. Using this, we predict that the stretching effect of the shorter focal lengths will put emphasis on the closest object in the picture frame, guiding the viewer's attention to hover around this object. Longer focal lengths will on the other hand compress the depth of the picture, making them appear more equal in importance.

3.3 Contrasts

Contrasts draw the attention of the human eye. This could be in the form of strong colours, or brightness of light (Ma and Zhang, 2003). Avoiding single points of contrast in a picture should keep the viewers attention moving around the frame to pick up as much information as possible. Using strong contrasts consciously will on the other hand help to steer the attention of the viewer towards certain areas of the picture.

3.4 Framing

By framing, we mean where we point the camera, how we orient the subject in respect to the background, and how tightly we crop pictures. This will affect both the amount of information included in the picture as well as which types of information that are presented together.

Framing the subject in front of an empty background should draw all the attention to the subject, while a detail-rich background will keep the attention of the viewer wandering around the picture. By changing the framing, the contextual information can be controlled, and thereby the interpretation of the viewer.

3.5 Needfinding insights from photography

Needfinding insight 3: By changing depth of field, focal length, contrast and framing, it is possible to control the output of the designer in terms of divergent/convergent thinking and guiding the direction of the project.

4 PICTURE TYPES AS NEEDFINDING TOOLS

Based on needfinding insight 3, we propose three types of pictures using the discussed effects of the picture parameters to support design teams in the needfinding process. We call these characteristic picture types: Snapshots, emphasized pictures and illustrated pictures.

4.1 Snapshot

Snapshots (Figure 3) are used to start the problem reframing process, supplying unfiltered, detail rich pictures to spark open-ended discussion. The main strength of the snapshot is to supply a context, and is not supposed to steer the viewer in any specific direction. Snapshots are unedited photos of a given situation. Except for the inherent choice done by the photographer when choosing to take the picture as well as colour adjustment, the viewer is not steered to emphasize any part of the picture. These kinds of pictures should avoid using strong dramaturgical effects to draw attention to specific parts of the frame, but rather try to capture as much information as possible. In order to achieve these qualities, we propose to use a large depth of field, short focal lengths, framing with detail rich backgrounds and little use of contrasts.

Figure 3: Snapshots

4.2 Emphasized picture

The emphasized picture (Figure 4) directs the attention of the viewer towards certain parts of the frame, which are found relevant by the needfinder or the design team using different techniques, including both composition while taking the picture and post-processing. These techniques decrease the degrees of freedom by literally narrowing down the problem space in the picture frame. Emphasized pictures are of the same situation as the snapshots that have either been shot or retouched in such a way that focus is drawn to a specific part of the frame. This is done because the needfinding photographer has identified this as a point of interest, and wants to emphasize the importance of this detail to the viewer. This can either be done subtly with dramaturgical tools, or explicit with retouching. The photographer can use tools as shallow depth of field, longer focal lengths, clean backgrounds and contrasts to achieve steer the viewer’s attention. To create emphasis in post-processing, the photographer can use crop, blur backgrounds and darken/lighten parts of the picture to increase contrast.

Figure 4: Emphasized pictures

4.3 Illustrated picture (Siddharth and Roy, 2015)

When insights start to crystallize and the design team reaches consensus on what needs they should address in their project, illustrated pictures (Figure 5) are used to freeze this information by striving to make this as unambiguous as possible. Everything considered unimportant by the photographer is removed by for example blurring and darkening. Important insights is then written and/or drawn on top to support and explain the content of the picture. Illustrated pictures should be used to explain a situation or an insight from the design team or the needfinding photographer. The goal is to ensure mutual understanding, by making information explicit. This can be seen as a further iteration of filtering from the emphasized picture, since the focus of the picture is analysed, and one specific bit of information is extracted. The illustrated picture can then be used as a basis for the resulting need statement that is handed over to the solution generation stage of the project.

Figure 5: Illustrated picture

5 CONCLUSION

We propose the conscious use of photography as a new tool in needfinding. By being in control of pictures taken and how they influence the viewer and design team, we hope to gain more insights toward the mechanics of the needfinding phase, and to be better equipped to increase the output quality, i.e. better the chances for the design team finding the “golden nugget”. Earlier in the text, three distinct types of pictures have been proposed to capture the various phases of the needfinding process (Figure 6): Snapshots, emphasized pictures and illustrated pictures. Each of these reducing opportunity for interpretation, focusing the attention of the viewer towards specific parts of the frame by obscuring or removing non-relevant information. The picture types have a dual purpose of priming the viewer with impressions, starting an iteration of narrowing down the final need statement, and to capture the outcome of each iteration in a visual manner to serve as either documentation of the process, or to prime the engineering design team in the next iteration cycle. We want to emphasize that the design team does not have to start the process with a snapshot and work their way through emphasized pictures and illustrated pictures. If the team already has sufficient knowledge of the problem, they can apply emphasized- or illustrated pictures directly in their process. We have already

done some pilot testing of the tools, and they prove to be high value versus time spent based on the feedback from one of our company partners.
The next step for us will be to convert our needfinding insights into testable hypotheses. We are currently working on an experiment, exploring the effect of depth of field (see equation 1 & 2) and focal length combined with eye tracking to capture data. By the time of the conference we hope to be able to present some early data.

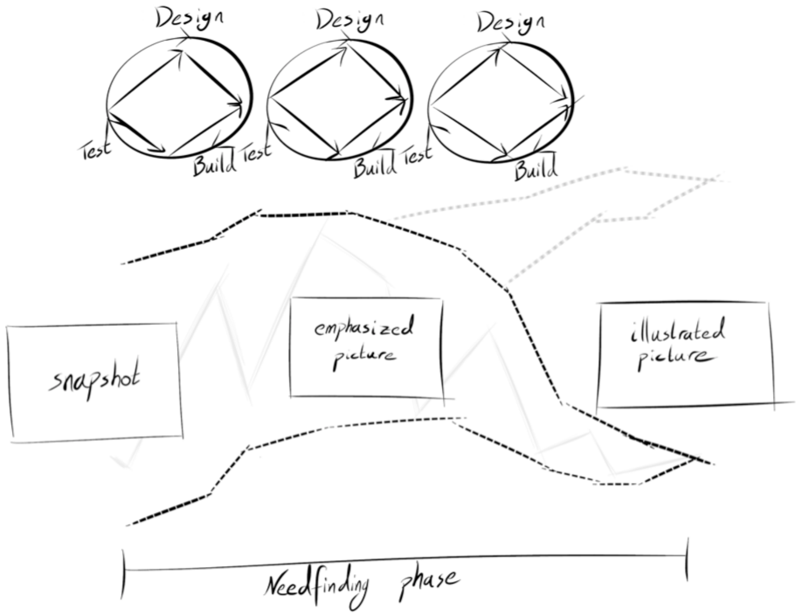

Figure 6: Photography needfinding process

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