

THE CHARACTERISTICS OF EXCELLENT DESIGNERS – FINDINGS FROM AN INTERVIEW STUDY WITH SWEDISH INNOVATORS

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Abstract

Some designers are more successful than others. They have the ability to repeatedly generate new and innovative solutions to challenging problems. In this paper, we refer to designers who possess this level of skill as “excellent designers”. It would seem interesting to identify the characteristics of such individuals in order to better understand why they succeed while ordinary designer do not. However, there have been few published studies of excellent designers, and these studies have focused on one or a few individuals.

In this paper, we account for a study of a larger group (15) of excellent designers. The aims were first to identify their particular set of knowledge, experience, working practices and personal characteristics and then to use the findings to generate proposals for how employers and educator can nurture excellent designers.

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1 INTRODUCTION

Innovative and cost-efficient product design is essential for any company's bottom line. The product development literature (e.g., Ulrich & Eppinger, 2011) is rich with proposals for methods, organizational structures or IT tools that will contribute to an innovative product development process. To an increasing degree, experimental studies are carried out to evaluate the utility of such methods, organizations and IT tools.

However, at the end of the day, individuals carry out product development. They do apply methods, work in teams and use IT tools, but they have their own personal background, experience, motivation and so on. Some individual product designers are consistently more successful than others. They are able to repeatedly develop truly innovative design solutions. In this paper, we refer to such individuals as "excellent designers". It would seem interesting to study such individuals in order to try to understand why they have become successful.

However, as pointed out by Petra Badke-Schaub at the ICED13 conference in Seoul, there have been rather few studies of excellent designers. One notable exception is Nigel Cross & Cross paper on the Formula One Car designer Gordon Murray and the "Dan" (1998). Some designer biographies, such as Isaacson's (2012) Steve Jobs biography, also identify some individual traits that characterized a particular designer. However, there has, to our knowledge, been very little research that has examined multiple excellent designers in order to investigate what they have in common that might differentiate them from "ordinary" designers.

The aim of this paper is therefore to identify individual factors that enable excellent designers to design truly original solutions, where ordinary designers are merely able to further develop existing ideas. Possible factors included personality, education, experience, mindset, motivation, support from the organizational environment and more. Our study is based on interviews with 15 Swedish designers, who all have a track record of successful innovations. Specifically, we aim to address the following research questions:

- What are the characteristics of excellent designers?
 - What knowledge and experience is essential for becoming an excellent designer?
 - What personal characteristics contribute positively to becoming an excellent designer?
 - What are the individual and collaborative working practices of excellent designers?
- How can educators and employers act to develop excellent designers?

The remainder of the paper is structured as follows: Section 2 accounts for the research approach of the paper. In section 3, we review the relevant literature, including studies of excellent designers, and expertise in a more general perspective. Findings are outlined in section 4 and discussed in section 5. Section 6 concludes the paper and makes proposals for future work.

2 RESEARCH APPROACH

The study comprised a literature study and an interview-based empirical study.

The purposes of the literature study was to define the meaning of design expertise and to identify factors that might characterise excellent product designers including education, experience, personality and so on.

The results were used to design the semi-structured interview guide that was used in the interviews. The questionnaire consisted of 16 questions, organized in five sections – personal background, education & career development, work methods, personality and views on innovation and creativity. The duration of the interview was 1.5-2 hours. The interviews were recorded, transcribed and sent to the interviewees for validation. The literature study indicated a possible link between excellence in design and personality attributes. The interviews were therefore complemented by a personality test. Two alternative personality tests were considered: The Myers Briggs Type Indicator (MBTI) (The Myers & Briggs Foundation, 2015) and the Big Five Inventory (BFI) test (McGrae & John, 1992; Zakrisson, 2010). As earlier studies had indicated a strong link between one of the BFI variables (openness) and creativity (confer section 3 below), the BFI test was chosen for the study. The BFI personality test element was voluntary. 11 out of 15 interviewees accepted to complete this test.

The selection of interviewees was guided by the findings of the literature survey. We searched for individuals known for being inventive and creative, who possessed a track record of *multiple* successful innovations (patented design solutions, commercialized products). The individuals should

further have long design experience and to possess the characteristics of an “expert” as outlined in section 3. Companies, academics and consultants were contacted in order to identify candidate interviewees. Finally, 15 interviewees were selected. Most were currently active as entrepreneurs, innovators or project leaders. Small, mid-size and large companies were represented. They were active in automotive, electronics, manufacturing and medical instrumentation businesses. The resulting sample size is smaller than some recommendations for qualitative research samples (Morse, 2000; as cited in Robson, 2002) that suggest that 30-50 interviews is an appropriate number. However, the characteristics of the candidate interviewees were carefully specified and the interviewees were interviewed in depth. Further, Griffin & Hauser (1993) showed that ten interviews will identify 90 % of a product’s customer needs, and that more interviews capture diminishingly fewer additional needs. We therefore argue that 15 interviews secured that a sufficient degree of ‘saturation’ in the data was obtained in order to provide a robust basis for the analysis.

In the analysis phase, about 100 quotes were selected and coded. Circa 30 codes were created and then further generalized into categories. Finally, four themes emerged as the organizing principle for the data. The final result is the model shown in Table 1.

3 LITERATURE STUDY

As stated above, the purposes of the literature survey were to define the meaning of design expertise, and to identify factors that might characterise excellent product designers including education, experience, personality and so on.

According to Ericsson et al. (2006), an “expert” is a person recognized for possessing a high level of knowledge and skills in a domain. An expert has a long or intensive experience gained through education and practice. Further, the term “expertise” refers to the characteristics, skills and knowledge that differentiates experts from novices and less experienced persons. Cross (2004) identified a number of aspects specific to expertise in design: The ability to work with limited new information, a focus of solutions rather than problems, and the ability to integrate aesthetic and technical problem solving. Cross further noted that experts may be less willing to change their working practices or concepts.

Experience and talent are needed to develop expertise, but the question is how much experience is required, and what is the importance of congenital traits? Ericsson maintains that experience expressed as hours of training is the most important factor and suggests that 10,000 hours of practice is both required and sufficient to become an expert in something. However, it also requires the proper combination of a strong motivation and the appropriate and targeted training. Other studies (Epstein, 2013) claim that training alone cannot guarantee the development of expertise, and point to the importance of various physiological characteristics for success in sports. However, there is a lack of studies on the respective importance of training and innate talent in design.

As noted above, there are few published studies of excellent designers. However, there are some including the already mentioned Cross & Cross study (1998) of the car designer Gordon Murray, and books on the Swedish inventor Håkan Lans (colour computer graphics, GPS-based coastal range ship tracking system) (Lagercrantz, 2013) and on Steve Jobs (Apple products) (Isaacson, 2012). Common for all three of these designers is made their first advanced designs very early, in their teens of early twenties, and they display an evident passion for what they do. These common traits indicate some support for the importance of innate talent (very early success) and motivation (passion). But the three designers also display unique traits: Murray’s working practices are described as systematic and problem-oriented, Jobs as a perfectionist aiming at integrated, aesthetically brilliant products, Lans has spoken about an “urge to realize ideas” as a key driver for him personally. These variations indicate that it might also be worthwhile to investigate if excellent designer adopt any particular effective working practices or thrive in particular working environments (“the appropriate training”) and the role of particular personal characteristics.

Relevant work can also be found within psychology where many researchers have studied personality traits and their relationships to skills such as idea generation (creativity) and problem solving. Specifically within the field of personality psychology, many attempts have been made to identify a universal set of personality attributes (Fahlke & Johansson, 2006). The assumption is these personality attributes can be rated and then associated with particular habits and behaviours in various situations. Various models within the area come equipped with test that are used to characterise individuals

according to the attributes and scales of the models. One of the most well known is the Myers-Briggs Type Indicator (The Myers & Briggs Foundation, 2015), in which personalities are characterized in four dimensions (Extrovert-Introvert, Sensing-Intuition, Thinking-Feeling, Judging-Perceiving) whereby 16 different personality types can be identified. For each of these personality types, typical behaviours are outlined. Another such model is known as the Big Five Inventory (BFI) model ((McGrae & John, 1992; Zakrisson, 2010). In BFI, five basic personality dimensions are identified: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness. Many studies have investigated the correlations between BFI domain ratings and personal habits and behaviours. Earlier work has found a positive correlation between a high rating for openness and creativity but also a negative correlation between agreeableness and creativity (King et al., 1996, George & Zhou, 2001; Yamagata et al., 2006). Creativity was hypothesized to be a common trait amongst the excellent designers, and the opportunity to investigate the potential correlation between a high rating for openness – creativity – excellence as designer enabled by the BFI test prompted us to include a BFI test in the study.

4 FINDINGS

In this section, the main findings of the study are described. Table 1 provides a summary of the findings, grouped into four main categories – general knowledge and skills, design knowledge & skills, personal attitudes and work environment.

4.1 General knowledge and skills

The respondents generally exhibit a broad knowledge base in combination with some specialization. They further generally possessed the skills of both working independently, were effective or rather purposeful communicators, able to generate ideas and solve problems.

The broad knowledge base was typically derived from a master’s degree in engineering. One interviewee had a background in dentistry.

Interviewee responses reflect both a need for a broad understanding in order to understand what is the problem (“*I was interested in the combination of medicine and engineering, I wanted to understand the whole context*”), and an urge to understand deeper in order to actually come up with solutions (“*I have to dig deeper into the problem in order to achieve something, but first I need to know what problem to solve*”).

Table 1. Excellent designers characterization.

General knowledge and skills	Design knowledge, skills, attitudes and working practices
<ul style="list-style-type: none"> • Broad knowledge base in <u>combination</u> with some specialization and interest in deep technical understanding • Ability to work independently <u>and</u> in teams • Effective communication skills • Idea generation skills • Problem solving skills 	<ul style="list-style-type: none"> • Strong customer empathy, including to improve for mankind • Involved in design process from start to end – strong wish to make ideas “real” • Design is a passion not a job • Use no or few “design methods” • Intuitive, flexible decision-making processes
Personal attitudes	Supportive work environment
<ul style="list-style-type: none"> • Curious • Self-confident • Boundary-stretching • Energetic • Perseverant • Optimistic • Open • Creative 	<ul style="list-style-type: none"> • Positive feedback nurtures will to create • Money is not the main motivator • Easy access to competent co-workers • Freedom from “rules” • A flat hierarchy with few borders • Sufficient resources

The excellent designers further exhibited the abilities to work independently, e.g. evidenced by that many had designed and built technical artefacts already as children, but were also able to work in collaboration with others. In particular, they were able to make use of other individual's competences, in order to reach a result. Further, the excellent designers had developed the communication skills needed to sell early ideas and concepts to management (*"Some people are great engineers, but when they present an idea it isn't clear enough, and then management cannot make decisions"*) as well as project management communication skills.

Finally, the excellent designers possessed idea generation and problem solving skills. Problem solving is described as a passion (*"I feel good when trying to solve a problem, it is like jogging"*). Combined, it seems that the ability to generate ideas is underpinned by a fundamental desire to understand the "problem" and the domain. Finding a solution to a hard problem, especially if it has not existed before, is described as a very strong motivator for the excellent designers.

4.2 Design knowledge, skills, attitudes & working practices

The interviewees positioned their interest and skills early in the design process in combination with a will to make ideas "real", i.e., finalize the project and put something in use.

They claimed to use few or formalized design methods for the key design tasks of problem analysis, idea generation and evaluation, similar to what earlier empirical studies have shown (e.g., Cross *et al.*, 1996). If they applied methods, they used simple methods.

The interviewed excellent designers spent, like Gordon Murray (Cross, 1998), much time on problem analysis. (*"Problem definition is much bigger than idea generation"*). Their starting point was thus early in the design process, they wanted to truly understand the problem and the customer's need, current and future. One designer described this as continually on-going process; involving both the internal thought process and direct involvement of customers in the design process (*"You have to put yourself in the customer's shoes"*, *"The customer should be involved from the start"*). However, this focus on early phases that echoes the drive to understand the "problem" is also combined with putting a high value on realize ideas. The excellent designers are not satisfied with handing off a customer needs' list to a design team but wish to also be involved in finding the solution and making it real. (*"An excellent idea which isn't realized is a bad idea but an average idea which is realized is a good idea"*).

Idea generation was by the interviewees described as an individual activity, and ad hoc rather than planned (*"suddenly the idea appears"*). Some of the excellent designers applied brainstorming techniques in their daily work, but others regarded brainstorming with scepticism.

Evaluation of designs does not appear to be done in a systematic and mathematical way (e.g. through concept scoring) but rather through intuition and quickly. They are able to let go of unfruitful ideas in order to focus their attention on viable ideas. (*"You have to be able to kill your darlings quickly"*). Nevertheless, they sometimes return to an old idea after a while, suggesting that some ideas are dependent on the appropriate timing.

Visualization methods, both in sketch form (whiteboards) and as computer models were highly valued as thinking and communication tools. Several interviewees brought forward the role of CAD communication with for selling the idea to the customer (*"I sat down and made a CAD model of the idea. The product owner bought the idea right away and wanted to submit the patent application and start the project immediately"*).

The interviewed designers design all the time, design is not something that they do only during office hours but around the clock. They keep on designing regardless of having been successful for a long time and in some cases rich (*"Telling me to stop designing just because I made some inventions, would be like telling Michael Jackson that he should stop making music after Thriller"*).

4.3 Personal skills & attributes

Personal skills and attributes generally exhibited by the respondents include curiosity, self-confidence, optimism, energy, perseverance and openness.

Many respondents describe themselves as very curious (*"I am an extremely curious person, I put my nose everywhere"*) (*"A good day is when I have learned something new"*). Many of the interviewed excellent designers had multiple degrees (in different fields) and have also been active in several fields, other indications of a strong interest to learning new things and areas.

Table 2. Results from Big Five Inventory test.

Attribute	Control group (average)	Excellent designers		
		(average)	(range)	(standard dev)
Openness	34.7	43.4	35 - 49	5.0
Neuroticism	20.2	18.4	13 - 23	3.5
Conscientiousness	35.0	33.3	25 - 41	4.4
Agreeableness	34.6	34.4	30 - 43	4.2
Extraversion	27.5	29.3	22 - 36	4.3

The designers further featured a strong self-confidence, they were not afraid to go against the stream and question existing norms and solutions (*"I am very little affected by other people's opinions. Of course, I listen to their factual arguments, but I am not worried by their reactions"*). (*"I am used to being an outsider, and that is a position that I am comfortable with taking"*). Closely related attributes include energetic and optimistic (*"I am energetic, bordering to wearisome"*). In the interviews, the respondents came across as very optimistic. They seemed to be unaffected by criticism (although positively encouraged by praise) and to not be discouraged by or reflect too much on failures or constraints. They were able to quickly move on to the next challenge. (*"I probably make more mistakes than the average person, because I dare to do many things, then you make many mistakes. But I don't care about that, maybe that's why I keep on going"*). Nevertheless, the respondents point out that the combination of interest and perseverance is critical (*"I think that perseverance is very important. You can be the brightest guy in the world, but if you don't have the perseverance, the idea will never become a real result"*).

The results from the Big Five Inventory personality test showed that for four out of five factors, there were only very small difference between the interviewed group of excellent designers and average persons. See table 2. However, for the factor "Openness" there is a significant difference, with the excellent designers rated as significantly more "open" than the average person. Openness is associated with personal attributes such as artistic, curious, imaginative, insightful, original and with broad interests (McGrae & John, 1992). High degrees of openness are associated with high creativity (King *et al.*, 1996). However, there are some exceptions: 2 of the 11 interviewees who took the test had a 35 score for openness, i.e. the as the average of the control group.

4.4 Supportive work environment

Finally, the designers were asked about what factors in the environment helped or facilitated for them to become excellent and to remain excellent. Feedback & incentives, working environments and resources were discussed.

Although many excellent designers claimed to be very confident and able to disregard criticism, many of them also mentioned that early and varied forms of positive recognition of their creations had been important for them, including encouragement from parents, awards and later patents. Some of the excellent designers had enjoyed considerable financial success, but nevertheless financial incentives were not perceived as a motivator. (*"Money isn't my driver. Sure, it's nice if you can make money, I am not arguing with that, but I would do this anyway"*). The motivation came more from the joy of the design activity as such and of seeing ideas become real. Money tended to be viewed as an enabler (*"Money is the toughest challenge, both emotionally and practically, to get the money that will enable the project to go all they way"*).

The working environment preferred by the excellent designers featured peer-like relations, freedom from "rules" and hierarchies and sufficient resources for getting the job done. They wished for tight contact with competent colleagues for immediate feedback on ideas. The role of management was to arrange resources and give encouragement, but not to meddle with the design work (*"Management is very important for making you visible and for feeling valuable"*).

The excellent designers wanted to be freed from rules, and tended to make strong connection between the freedom from rules and their space to create new solutions, i.e. doing the thing that they enjoyed most. One respondent claimed that there are two main categories of people: creative people and rules people. *"Creative people create the future and rules people try to hold it back."*

It could be pointed out that the work environments preferred by the excellent designers are fundamentally well aligned with factors that have been found to strengthen work motivation in general (e.g. Katzell & Thompson, 1990).

5 DISCUSSION

5.1 Implications for employers

The excellent designer's wishes for the perfect working environment seemed to be free from rules, and with close contact with equally competent co-workers. The excellent designers were not particularly motivated by salary or by typical fringe benefits such as company cars or gym club membership. Their motivation rather came from a will to push limits, make things real, solve problems. The role of management was seen as a provider of resources and of encouragement, not control or meddling in the daily work. Managers need to develop a high degree of trust towards their excellent designers. The excellent designers did acknowledge the need to maintain a positive relation to management in order to obtain resources to realise their ideas, they did not seem to wish to be seen as contrary. In fact, there are striking resemblances between the working environment requested by the excellent designers, and with published lists of factors that characterise motivating work environments (Katzell & Thompson, 1990). There are also published descriptions of working environments that seem to match the excellent designers' request, e.g. at Google, at discussed by Steiber & Alänge (2013). It is at the same time clear, however, that it can be a challenge to balance the wishes for freedom, autonomy, and smallish working teams with the need to standardize and rationalize operating procedures in large companies with lower profit margin than Google.

Many of the excellent designers had a very strong customer orientation, which may be related to a high degree of openness. Management has a clear task here, namely to organize the product development activities so that designers have direct contact with users/customer and even personal experience of the use of products. This is essential for bringing about the deep understanding of the problem needed to come with a solution to a hard problem.

At this point, it may be argued that these demands on the working environment and on direct customer contact are voiced by "ordinary" and "excellent designers" alike. As no "ordinary" designers were interviewed we cannot validate such a claim fully or partially. But, if this is true, the implication for management would be that designing the working environment for getting the most out of the excellent designers would also mean that the ordinary designers would thrive. This is an interesting topic for a future study.

5.2 Implications for educators

It is evident that some of the common traits of the interviewed designers (a combination of deep understanding of the problem and a drive to realize ideas practically, ability to work in teams and communicate effectively etc.) are characteristic also for modern engineering education concepts such as the CDIO (Conceive-Design-Implement-Operate) approach (Crawley *et al.*, 2014) and learning environments such as the Stanford D School.

However, some other aspects may motivate special consideration. It was clear that the designers were able to design both individually and in a team setting. An education that heavily lies on team-based design project might consider introducing some individual design-build-test projects, along with modules on self-awareness and self-leadership.

Further, the interviewees stressed the importance of a deep understanding the customer and the problem. So, design learning experiences should not provide a completed problem statement or requirement specification to the students, but rather start further upstream and enabling the students to spend time on problem identification and analysis.

The designer also expressed their preferences for a working environment free from procedural rules, a wish to stretch boundaries, and recognition of their accomplishments. It would seem that student competitions, such as Formula Student and Shell EcoMarathon, are very suitable for this purpose. These educational experiences already exist but what an educational institution needs to do is realise their value and to provide supporting learning spaces and funding for parts and travel.

Finally, the excellent designers featured some personality traits that, it should be recognized, may be very difficult to explicitly train, including curiosity and openness. Such traits may be encouraged by

an education setting which provides students which a relatively high degree of freedom of choice of topics and specialization. It may also be factor in designing student admission, complementing SAT scores with evidence of curiosity and openness.

6 CONCLUSIONS AND FUTURE WORK

This study aimed to identify factors that characterise excellent designers, and to propose how the understanding of such factors can help educational institutions and employers plan how to develop their students or their employees design skills.

The excellent designers that we have interviewed showed a high degree of openness coupled to creativity, combined a broad knowledge with specialist knowledge in some area, were characterized by curiosity and a continual ambition to learn, combined the ability for independent work with the ability to obtain the proper help from others. They preferred an open and flexible working approach as opposed to applying pre-selected methods. They were optimistic and not afraid to try-and-fail, they viewed that as an opportunity for learning. They had a strong empathy for customer needs coupled with the ability to predict future customer needs.

Educations that aim to develop excellent designers can include a variety of competitions where there is an opportunity to challenge existing borders. Projects in such an education should, at least in the upper levels, allow for the freedom to select own working practices and support the realization of student's own ideas. Excellent designer educations should develop broad and specialised disciplinary knowledge and teamwork training but also include learning experiences aimed at self-awareness and self-leadership, and continually nurture student curiosity. Employer who wish to create a working environment that supports excellent designers should aim for a flat organizational structure with a high degree of trust in the excellent designers, little bureaucracy, and actively organize for the involvement of customers in the design process.

The excellent designers interviewed for this paper all had their experiences from discrete, manufactured products and were Swedish. Beyond this scope, it is not clear how transferable the findings are. Interesting continuations of this work would be a study of designers who had designed other kinds of products, such as software or drugs, as well as a study of an international group of designers. In the study, only "excellent" designers were interviewed. A future study could interview "ordinary" designers in order to investigate to what degree the identified personality traits and requests on working environments are particular for excellent designers, respectively are representative for both groups.

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