Designer's Professional Identity: understanding composition, development, and perceptions

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Designer's Professional Identity: understanding composition, development, and perceptions

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To my family in Brazil and all those who made this journey possible with their continuous support and inspiration

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Abstract

Designers' Professional Identity (DPI) is a psychological construct helps designers identify themselves as professionals and as belonging to a professional group. As an identification mechanism, it has a great influence on a designer's attitudes and behaviour, which are fundamental aspects of a designer's professionalism. Based on characteristics derived from relevant literature, DPI is described as being composed of two key elements: personal qualities (PA) and design qualifications (DS). This thesis evaluates these elements with regard to situational awareness, development over time and the relationship between professional expectations, self-identification and self- and socially perceived differences. This PhD project: (1) examines DPI as a dynamic process for professional identification (2) builds on literature explaining that personal identity (PI) requires a context-sensitive attention and (3) highlights self- and social perceptions as major components of DPI.

This thesis is formulated as a collection of articles, which makes use of a current literature, survey questionnaire, and semi-structured interviews for data collection in both educational and professional environments. Three studies were conducted and the most important contributions from this are: (1) the identification of the specific elements that contribute to DPI and then the integration of these elements from the design literature to the general literature on PI; (2) the understanding of DPI's development over time through Education, Awareness, Expectation, Motivation; (3) the understanding of differences in self- and social-perceptions regarding the role of designers and the DPI elements. Thus, the three studies carried out in this project provide considerable insights for education and industry with regard to DPI elements, identity development, and differences between self- and social-perceptions within design engineering. Furthermore, the studies highlight theoretical gaps and make suggestions for further research in the field.

Abstract på dansk

Designerens Professionel identitet: forståelse sammensætning, udvikling, og opfattelser

Designers' Professional Identity (DPI) er en psykologisk konstruktion, der hjælper designere til at identificere sig som fagfolk og tilhørende en professionel gruppe. Som identifikationsmekanisme har den stor indflydelse på en designers holdninger og adfærd, hvilket er grundlæggende aspekter af en designers faglighed. Baseret på karakteristika hentet fra relevant litteratur beskrives DPI som værende sammensat af to nøgleelementer: personlige kvaliteter (PA) og designmæssige kvalifikationer (DS). Denne afhandling evaluerer disse elementer med hensyn til situationsbevidsthed, udvikling over tid og forholdet mellem faglige forventninger, selvidentifikation og selv- og socialt opfattende forskelle. Dette ph.d.-projekt: (1) undersøger DPI som en dynamisk proces til faglig identifikation (2) bygger på litteratur, der forklarer, at personlig identitet (PI) kræver en kontekstfølsom opmærksomhed og (3) belyser selv- og socialperceptioner som hovedkomponenter af DPI.

Afhandlingen udgøres af en samling artikler baseret på dataindsamling, der er foretaget ved hjælp af spørgeskemaundersøgelser og semistrukturerede interviews i både uddannelsesmæssige og professionelle miljøer. Tre studier blev gennemført og de vigtigste bidrag herfra er 1) Identifikation af de specifikke elementer, der bidrager til DPI og derefter en integration af disse elementer fra design litteraturen til psykologien; 2) forståelsen af DPIs udvikling over tid gennem uddannelse, opmærksomhed, forventning, motivation; 3) forståelsen af forskelle i selv- og sociale opfattelser med hensyn til designernes rolle og DPI-elementerne. De tre undersøgelser, der udføres i dette projekt, tilfører således betydelig viden til uddannelse og industri med hensyn til DPI-elementer, identitetsudvikling og forskelle mellem selv- og sociale opfattelser inden for designteknik. Desuden fremhæver undersøgelserne teoretiske huller og fremsætter forslag til yderligere forskning på området.

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Summary

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1. Introduction

Professional Identity (PI) —also referred to as occupational identity— is the dynamic process of social- and self-understanding as a professional. The PI development process involves the conscious awareness of oneself as a worker (Skorikov & Vondracek, 2011), where both social- and self-perception play an important part. In this sense, PI is influenced strongly by context, relationships and broader social factors (Baumeister & Muraven, 1996; Cohen-Scali, 2003). As a dynamic process, an individual's overall sense of PI develops over time and is reshaped based on situational awareness (mind-set, roles, responsibilities, current awareness) and reflection upon perceived competencies (Personal Attributes (PA) and Design Skills (DS)) and/or expectations (actions, goals, beliefs and values) (Cruess, Cruess, & Steinert, 2015). This identification mechanism drives attitudes and behaviours that are fundamental aspects of professionalism (Cruess et al., 2015; Marquardt et al., 2016), such as performance (Adams et al., 2011), career decisions (Lichtenstein et al., 2009), psychological wellbeing (Sharma & Sharma, 2010) and mental health (De Goede et al., 1999).

The professional identity of designer's differs from other professions due to the uncertainties relating to the boundaries to of the professional activities, which affects the consolidation of a PI (Tracey & Hutchinson, 2016). Designers' Professional Identity (DPI) development is assumed to start during higher-education and becomes especially relevant in the transition from student to professional (Mann & Nouwens, 2009; Skorikov & Vondracek, 2011; Trede, 2012b), when perceptions in the early career stage contribute strongly to professional decision-making, e.g., commitment to the profession or dropout (Lichtenstein et al., 2009). During this transition, young designers face many difficulties in adapting to a work environment and the complexities of the field (Evetts, 2003; Tracey & Hutchinson, 2013). In this sense, professional aspects become a major psychological component of the person's overall sense of identity, by dealing with the complex structure of meanings related to professional roles, individual motivations and competencies (Baumeister & Muraven, 1996). Thus, the balance between social- and self-perceptions plays a fundamental role in the construction of the DPI, where inconsistencies and misalignments could lead to professional drop-outs (Khapova et al., 2007; Worthington et al., 2013).

Establishing a well-defined sense of identity is important for the designer's self-development and crucial for Design to flourish as a profession (Norlyk, 2016). A weak DPI can have a direct influence on the quality of the designer's work and, thus, can affect the image of Design as a profession (Murphy, Chance, & Conlon, 2015; Woo, 2014) – creating confusions that could impact not only on problem-solving performance but also on the capacity to perform ethically as a professional. The broader concept encompassed by and describing the term *designer*, identifies a range of different professionals and activities that use problem-solving strategies in projects (Visser, 2006). However, problem-solving ability has become essentially multidisciplinary and extends beyond the boundaries to professions. In addition, the design field is broad and changes over time, which influences PI (Buchanan, 1992; Kleinsmann et al., 2017).

PI as topic for research within the field of design is emerging and underdeveloped. However, authors such as Littlejohn (2011) and Tracey & Hutchinson (2013, 2015) have explicitly investigated this topic. Littlejohn (2011) analysed data on students enrolled in four US graduate design programmes, collected via interviews, documentation and observations. Tracey & Hutchinson (2013, 2015) explore

how instructional design students use reflective practice to develop the foundations of their PI – particularly within a design thinking framework – and how they reflected on their experience and beliefs regarding uncertainty. Both studies adopt a qualitative approach and show that personal attitude and personal behaviour express important elements of a designer's, while reflection in the context of uncertainty can help the development and maintenance of identity. There is an established body of knowledge on the related concepts of professionalism, professionalization and expertise development in Design that could be a stepping stone to further research on DPI development (see, e.g., Ahmed & Wallace, 2004; Ahmed, Wallace, & Blessing, 2003; Atman et al., 2007; Beegan & Atkinson, 2008; Cross, 2004; Deken et al., 2009; Deken et al., 2012; Dorst & Reymen, 2004; Dym et al., 2005; Eris & Leifer, 2003). These concepts have been found to be important to improve design practice and education.

Nevertheless, there are several gaps in the design research literature related to the theoretical foundations and empirical evidence related to the PI of design engineers. First, the elements that contribute to DPI and the self- and social-constructs that reflect professionalism are not well defined. Although some prior studies suggest professional development paths, based on observation of expert practice and abilities, how the development of design expertise leads to the development of DPI is unknown and, similarly, very little is known about the psychological aspects of the DPI. Second, how DPI develops over time, especially during the transition from student to professional life, is unknown. Third, we lack knowledge about how the DPI development process is influenced by changes in the social- and self-perceptions experienced by a designer. The aim of this thesis is to propose advance out understanding and identify some of the factors contributing to the process of PI in Design, the dynamic process of DPI development and the influence of different social- and self-perceptions. The thesis includes three studies exploring three different aspects of DPI:

- ***The elements constituting the DPI***:
  RQ1) What are the elements that comprise DPI?
- ***The dynamism of DPI elements and career over time:***
  RQ2) How does DPI develop and how do designers at different career stages self-identify?
- ***The differences in social- and self-perceptions:***
  RQ3) What are the social- and self-perceptions related to the role of the designer and DPI?

Thus, this thesis research adopts a novel approach to the investigation of these topics in the field of design and extends previous work on DPI by identifying different elements of DPI derived from the core design literature (Chapter 4). It provides an initial operationalisation of these elements and offers an overview of career expectations and motivations (Chapter 5). It provides an in-depth evaluation of social- and self-perceptions regarding DPI and the professional role of designer (Chapter 6). As such, it is hoped that this thesis will advance out understanding of DPI.

1.1 Background and problem definition

PI is a dynamic process of identification within a professional practice, that is built on context-sensitive awareness and includes two main components: self- and social-perception of professionalism (Baumeister & Muraven, 1996; Murphy et al., 2015; Skorikov & Vondracek, 2011). Self- perception and social-perception develop symbiotically within a life-long learning process. The development of PI is related directly to professional development and experience (Wenger, 1998a) and recognized through rewards and public acknowledgment (Skorikov & Vondracek, 2011).

Self-perception is related to the construction of self-understanding as a professional through professional skills (Baumeister & Muraven, 1996; Norlyk, 2016), where self-identification and awareness seem to develop in parallel or as a function of expertise. Self-perception often develops over years of practising and is influenced directly by personal environment, context and established values (Bosma & Kunnen, 2001a). The process starts during education and gathers pace during the professional life as a result of membership in professional networks (Dobrow & Higgins, 2005b) and external perceptions of the profession (Smith & Whitfield, 2005; Smith, 2015). The education and expertise development processes promote the abilities required to master the practice. At the same time, the interactions between individuals contribute to the development of a range of self-understandings upon which the individual draws to construct his or her PI (Williams, 2013). Thus, integration and social-interactions foster consolidation of PI by shaping mind-sets based on the acquisition of knowledge (Lave & Wenger, 1991). Hence, self-perception is connected to and influenced by the external world, the mind-set developed and the capacity for self-evaluation and regulation (Wenger, 1998a).

Social-perception refers to peer recognition and social support (Cohen-Scali, 2003; Skorikov & Vondracek, 2011) and allows individuals to make sense of themselves and their work (Godsey, 2011; van Knippenberg et al., 2004). The external aspects are embedded in the professional group and dictate its members' shared values and requirements (Cox, 2005; Lave & Wenger, 1991). The alignment to social-perception increases with the development of expertise over time, culminating in the consolidation of a PI based on social integration and the network construction (Dobrow & Higgins, 2005b). Social-perception provides validation of the expertise development process and a positive stereotypical social identity (Cohen & Garcia, 2008) on which self-understanding and the PI build. The function of a professional education is to kick-start the alignment between these values and meanings and provide training to improve technical abilities (McDonnell, 2016). Design education includes the ability to achieve high standards and exploit well-established practices that facilitate the progression from novice to expert (Cross, 2004). This aspect highlights the importance of the education system and the development of expertise in the process of identification (Tracey & Hutchinson, 2015). Also, social inclusion in a community of practice contributes fundamentally to the construction of identity and belongingness (Baumeister & Leary, 1995). Integration within a group of practitioners fosters learning aligned to the community's values and expectations and can be more important for identity formation than academic knowledge and training (Schwier et al., 2004). Thus, social-perception in the context of professionalism sets goals and expectations related to professional development (Bothma et al., 2015; Haslam & Ellemers, 2011), facilitating a process of negotiation among learning, uncertainty, belongingness and self- and social-acceptance (Baumeister & Muraven, 1996; Skorikov & Vondracek, 2011; Wenger, 1998a).

Both social- and self- perception and the processes of identification and expertise development, begin to evolve with engagement in the professional practice. Baumeister & Muraven (1996) explains that work is usually done for the sake of identity-building, such as gaining advancement and recognition that validate the self and embody our individual characteristics on the act of being a professional (Dall'Alba, 2009; Luehmann, 2007). Establishing a well-defined sense of identity is important for the designers' self-development, and crucial for design to flourishing as a profession (Norlyk, 2016; Woo, 2014). Having designers with a weak professional identity may have a direct influence on the quality of their work, and thus influence the image of Design as a profession (Woo, 2014).

The professional identity of designer's differs from other professions due to the uncertainties relating to the boundaries to of the professional activities, which affects the consolidation of a PI (Tracey & Hutchinson, 2016). Thus, the first steps towards understanding identity formation require knowledge about what is understood socially as fundamental for the designer's PI, and an understanding of the differences between the perceptions of the designers and those of influential societal actors. In this thesis, I argue that the combination of the elements of PA and DS provides a holistic overview of the designer's professionalism characteristics that can be understood in terms of self- and social-perceptions and might reveal how DPI is constitute and develops.

1.2 Research questions and objectives

The studies that comprise this thesis contribute to a process of theory building regarding the development of DPI. The aim is to provide an understanding of designers' characteristics and the elements contributing to the designer's PI, in the context of design engineering, its development and the differences between self- and social-perceptions of the profession. The overall objective is to construct a framework based on a combination of the designer's personal/behavioural traits and design expertise, to describe the formation of DPI and its evolution over time. This includes a) the identification of the elements contributing to DPI, based on the mapping of descriptions in the design literature; b) understanding DPI development over time in the contexts of education, awareness, expectation and motivation; c) understanding the differences in self- and social-perceptions regarding the designer's role and the DPI elements. The research approach and basic assumptions are defined based on the literature, and analysed empirically. Each empirical study is presented in the form of a journal article and constitutes a thesis chapter. Table 1 presents the research objectives and the research questions.

Table 1. Research objectives and questions

Main Objectives	*Research Questions*	*Thesis structure*
1) Identification of the elements contributing to DPI, based on the mapping of descriptions in literature	*RQ1) What are the elements that comprise DPI?*	*Chapter 4*
2) Understanding DPI development over time in the contexts of education, awareness, expectation and motivation	*RQ2) How does DPI develop and how do designers at different career stages self-identify?*	*Chapter 5*
3) Understanding the differences in self- and social-perceptions regarding the designer's role and the DPI elements	*RQ3) What are the social- and self-perceptions related to the role of the designer and DPI?*	*Chapter 6*

2. Theory and Research Field

The development of a PI essentially concerns the construction of self-understanding and a social image that allows identification with a group or a community of practice (Skorikov & Vondracek, 2011; Wenger & Trayner-Wenger, 2015). The terms 'identity,' 'occupational identity' and 'professional identity' have been discussed in psychology and academic discourses in other fields. However, in many contexts, their meaning is ambiguous, which is a barrier to the adoption of this body of knowledge by other study areas. In this chapter, I define these terms and how they might be meaningful in the context of Design. This chapter begins by a) discussing the fundamentals of PI theory, and then b) examines the concept of PI in the field of Design. The succeeding sub-sections discuss c) the use of developed knowledge and expertise in identity development, d) the role of education in the development of a strong identity, and e) the synthesis of the discussed knowledge and generic learnings about the construction of identity in the Design community of practice. This framework provides a conceptual lens that is exploited in the succeeding chapters to examine and analyse the data.

2.1 Professional Identity theory

The PI literature draws mainly on the field of psychology. However, in work on communities of practice, PI or occupational-identity, career-identity or work-identity, encompasses a range of niche-oriented research in many fields of application. Some of these fields, describe long term efforts to build a body of knowledge (e.g., nursing and teaching) in order to improve practitioners' mental health and psychological strength.

What is professional identity?

PI is considered a state-of-mind or a level of awareness that allows identification with a specific group of professionals. Professional consciousness is a core element in a person's overall identity and, thus, plays an important role in individual confidence and professional development (Skorikov, & Vondracek, 2011). The sense of belonging to a group and, so, to a profession, is integral to the self and is reflected directly in individual development and performance in the work context.

According to Baumeister & Muraven (1996), personal identity refers to the individual adaptation to a sociocultural context, created by the history, culture and proximate structure of social relations, in which the individual identity must exist. In contrast, PI is considered to be a context-related aspect of the whole individual identity and has been defined as dynamic understanding of professional responsibilities, actions, beliefs and values by synthesizing knowledge.

Research shows that there are both personal and social dimensions to PI and, also, that the influence and perceptions of others are critical elements. According to Dent & Whitehead (2001, p. 11), "identity is neither stable, nor a final achievement". Rather, it is a never-ending process which ends only with the anchoring of its meaning in relation to the "Other". Thus, social context affects the way that professional identities are formed (Gomes & Teixeira, 2000), while the interactions between individuals contribute to the development of a range of self-understandings on which the individual can draw in the process of constructing a PI (Williams, 2013). The development of a personal- and a professional identity is related directly to individual professional development and experience and

their existence is recognized by rewards and acknowledgment; a career consists of a record of promotions, honours and marks of distinction.

In the work context, "others' reactions shape the evolution of identity in two primary ways: by validating (or failing to endorse) new behaviours, and by providing feedback about how to improve" (Ibarra, 1999, p. 12). Thus, work is aimed usually at identity-building in the form of career advancement and recognition, which validate the self (Baumeister & Muraven, 1996) and embody individual characteristics related to the act of being a professional (Dall'Alba, 2009; Luehmann, 2007).

Identity development through group belongingness and practice

Being a professional increases the feeling of belongingness to a social group, which, according to the definition of personal identity in Baumeister & Muraven (1996), triggers perception of the self. Understanding the importance and construction of belongingness (Baumeister & Leary, 1995) through learning and development of skills, connects the PI and personal identity. This learning process involves *situated learning* (Lave & Wenger, 1991); it does not refer to mere acquisition of certain forms of knowledge, but is part of a social relationship. In this sense, identity formation, acquisition of knowledge and social membership are intertwined.

The construction of identity through practice relies on constant negotiation of the ways of being in a given context (Wenger, 1998a). Professional practitioners (e.g., engineers), especially when grouped according to their specific area of interest, can be considered a *community of practice* or an *occupational community,* organized around a particular area of knowledge and activity and giving community members a sense of joint enterprise and identity (Cox, 2005; Lave & Wenger, 1991). In other words, development of a professional identity involves praxis: ways of doing and approaching things that are shared to some significant extent among the members of a determined group. Professional group belongingness and the network of other professionals within a community of practice – as well as formal education and work recognition – embrace and facilitate the understanding of roles, practices and professional development. Wenger (1998) identifies six main categories that characterize the parallel development of identity and practice:

1) ***Lived:*** *identity* is not just a category, a personality trait, a role or a label; it is more fundamentally an experience that involves both participation and reification. Hence, it is more diverse and more complex than the terms categories, traits, roles or labels would suggest.
2) ***Negotiated:*** identity refers to 'becoming'; identity work is ongoing and pervasive. It is not confined to specific periods in the individual's lifetime, such as adolescence, or to specific settings, such as the family.
3) ***Social identity:*** Community membership endows identity formation with a fundamentally social character. Membership is manifested in the familiarity with certain social contexts.
4) ***Learning process:*** An identity is a trajectory in time that incorporates both past and future into the meaning of the present.
5) ***Nexus:*** An identity combines multiple forms of membership through a process of reconciliation across practice boundaries.
6) ***Local-global interplay:*** An identity is neither narrowly local to activities nor abstractly global. Like practice, it involves an interplay of both dimensions.

The above categories provide an understanding of identity aspects based on acquisition of expertise and the structure of the given community of practice, and make it possible to identify the professional's perceived strengths and weaknesses. However, the perceived standards for the practice are dictated by a social construct. Understanding and managing behaviours to be socially acceptable is required for professional realization and a stronger professional identity, and improves work performance.

Cohen & Garcia (2008) explain that 'belonging uncertainty', i.e., doubt about acceptance or rejection by key figures in the social environment, can affect individual engagement and motivation and avoid a negative stereotyped social identity. Furthermore, the conception of performance relies on established social constructs and perceptions within a community of practice. Often, performance is correlated to the generated value in the form of outcomes such as speed, revenue or quality. For the professional, performance is evidence of the mastery of technical abilities and acquisition of expected characteristics, alignment to community values and achievement of higher level outcomes and expertise. These aspects consolidate a positively related image (social identity) within the group and strengthen the network based on trust and reliability.

In a multidisciplinary community, such as Design, since neither the professional nor the PI is static, there are some major difficulties related to establishing and developing a PI (Ahlgren & Tett, 2010; Baumeister & Muraven, 1996). For example, the negotiation of meaning, social positioning and reward, and the balance between expectations and reality. Thus, social- and self-understanding of the designer's professional identity play a fundamental role in education as well as professional development and career progression.

2.2 Professional Identity in Design

The definition of Design as a discipline can be difficult (Ulrich, 2011) and the uncertainties about the boundaries to of the professional activities affect consolidation of a PI (Tracey & Hutchinson, 2016). The manufacture of objects has a long history and so the understanding of design as a profession. Design education initially was based on a master-apprentice relationship in arts & crafts. It then progressed to a university-based system, focused on product- and systems engineering. Thus, design as a profession is in constant flux and the inclusion of new and diverse fields has resulted in PI and formal design education requiring constant adaptation.

Design was first recognized as a profession with the implementation of the first design schools, such as Bauhaus in 1919. According to Huppatz (2015, p. 188), the historical definition of design is based on the manufacturing of objects:

> If we define design as the conception and creation of artefacts for mechanized mass production—'industrial design' in its purist sense—then the British Industrial Revolution of the eighteenth century seems a logical origin. However, if we define design as the conception and creation of useful artefacts in general, then the scope of inquiry expands to include 'pre-industrial' objects.

While design as a profession has advanced, the field (and its practitioners) are still in the process of developing and discovering a PI. The term design seems not to be helpful for developing identification and to the professionals start to be seen as something specific, which in fact might not be possible. In discussing some specific characteristics of designers some authors suggest that design is so intrinsic with human nature that cannot be dissociated from the human capability to think (Simon, 1996). It

has been suggested also that the ability to design is a part of human intelligence (Cross, Open, & Keynes, 1999) since design activity has been present since the beginning of the human history in relation to developing solutions to the most basic life problems.

The broader concept encompassed by the term *designer* refers to a range of different professionals and activities - architects, engineers, industrial designers (graphic and product) and all the individual branches that apply problem-solving strategies to projects (Visser, 2006). During the last few years, the design field has incorporated many new areas and challenges of modern society. According to Gardien et al. (2014), being in sync with sociocultural and technological changes and overcoming outdated mind-sets and old paradigms is necessary to extract value from the marketplace. It means that professionals and companies need constantly to find new ways of working. The ability to solve problems is requiring multidisciplinary knowledge that goes beyond individual professions and requires solutions to complex/real problems across mixed knowledge areas, which affect societal developments and contemporaneous aspects.

Nevertheless, in the context of Design PI is an essential aspect that requires investigation. A well-defined sense of identity is important for the designer's self-development and crucial for design to flourish as a profession (Norlyk, 2016). A weak PI will have a direct influence on the quality of the designer's work and affect the image of Design as a profession (Murphy et al., 2015; Woo, 2014). This can create confusions that can influence problem-solving performance and, also, the capacity to perform ethically as a professional. Professional group belongingness and the networks with other professionals alongside formal education and work recognition, facilitate an understanding of roles, practices and professional development. Group belongingness is especially important in the job market in relation to human resources selection, management of team members and the balance between professional characteristics and expectations in projects or jobs.

The progression of self- and social-identity construction demands interaction among psychological, cognitive and technical aspects. However, this interaction allows behavioural insights related to recognition as a design professional. At the individual level of PI, a designer must be able to understand his or her role and responsibilities; the designer needs to have a sense of satisfaction and pride in the chosen field and in representing the profession (Patall, Sylvester, & Han, 2014; Skorikov & Vondracek, 2011). This requires acquisition of expertise and skills and a professional approach, i.e., a holistic approach to the designer (Dall'Alba, 2009).

Being a professional increases the feeling of belonging to a social group, which, according to the definition of personal identity discussed in Baumeister and Muraven (1996), trigger perception of the self. An understanding of the importance and construction of belongingness (Baumeister & Leary, 1995) through learning and skills development, connects the person to his or her professional identity. The blending of personal and professional attributes provides a holistic overview of professional identity. Designers' activities have been studied mainly as design skills and assuming that personal attributes are accessible on the native capacity that every human being has to design (e.g., small everyday tasks).

2.3 Design expertise and competencies in PI development

Design expertise is a field of design studies. It is used to evaluate expert performance in design (Cross, 2004). According to Lawson and Dorst (2009, p. 82), "expertise consists of characteristics, skills and knowledge that distinguishes experts from novices … [whether it] seems to be a set of learned skills and knowledge probably based on some personal characteristics that facilitate this learning". In this sense, the study of design expertise can be used as basis for investigating professional identity in design, based on competency expectations and skills development.

It is generally believed that expertise develops over time as the individual matures and achieves peak performance, after which there is an inevitable decline (Cross, 2004, p. 427). Development of expertise requires a period of deliberate practice and training (Ericsson et al., 1993) and sustained involvement of the subject in the community of practice and its professional education and activities (Golja & Schaverien, 2007; Wenger, 1998). It has been estimated to take some eight to ten years from first involvement to the achievement of expert performance and international peer recognition (Ahmed, 2007). Thus, the accumulation of professional design experience is vital to the process of becoming an expert (Cross, 2004).

During the development of expertise, the designer experiences different phases of training and education as a novice, and professional practice in internships and finally expert experience. Motivation, concentration and a willingness to work hard to improve performance play vital roles (Ericsson, 1993). The accumulation of knowledge through experience and learning (e.g., formal education), contribute to skills development and lead to expertise based on "stored experience of the actual outcomes of tens of thousands of situations" (Dreyfus & Dreyfus, 2005, p. 788). Thus, development of expertise is a complex non-linear process in which each aspect of expertise evolves with some skills more developed than others (Lawson & Dorst, 2009, p. 94). For example, Kleinsmann et al. (2012), show that collaborative design skills do not evolve at the same rate and in the same time as more general design skills. In a professional context, expertise can be the result of stored experiential knowledge and reflection, mature skills, practice and personal attributes (e.g., self-confidence). These elements co-evolve with the designer's PI in a context of behavioural adaptation (Larsson et al., 2009; Tynjälä, 2008).

Expertise can be both an individual and a collective (team) attribute and is both a social and a cognitive construct (Lawson & Dorst, 2009). DPI has both social and psychological aspects (Baumeister & Muraven, 1996; Norlyk, 2016). The former are related to peer recognition and social support (Cohen-Scali, 2003; Skorikov & Vondracek, 2011), reinforced by years of practice (expertise development), development of professional networks (Dobrow & Higgins, 2005b), and contextual factors that influence external perceptions of the profession (Smith & Whitfield, 2005; Smith, 2015). The latter refers to the construction of a self-understanding as a professional through professional skills, in which psychological self-recognition seems to develop in parallel with or as a function of expertise.

2.4 Design education for PI development

Design education is important for defining and developing DPI. However, as formal design education moved from the workplace (traditional crafts) into colleges and universities, DPI development became based more on theory development and learning-by-doing academic experience. The incorporation of new fields and the perception of new complex problems, result in designers who can "no longer be trained to follow a set of procedures since the rate of change of the world in which they must work would soon leave them behind" (Lawson, 2005, p. 6). Thus, design students "must learn to appreciate and exploit new technology as it develops" rather than becoming immersed in the practices of a few traditional crafts (Lawson, 2005, p. 6). Margolin (2003, p. 355) discusses the dilemmas related to design engineering education in terms of developing professionals who are more than just a set of technical skills:

> With a few exceptions, design schools offer no resistance or alternatives to the market model. Students are preoccupied with learning a set of skills that will qualify them to get a job and they receive no indications that design is about anything more than producing goods for the market. While the best schools do train well-qualified professionals and raise issues about ethics, users, sustainability, and so forth, none that I know of deal with these topics in any way that challenges the dominant paradigm of practice. What remains mostly invisible are the ways that designers could contribute to social change, either by identifying socially useful projects within the market structure or else working as paid professionals who provide a service outside the market.

When learning becomes part of daily life, there is an intimate connection between knowledge and activity. Thus, for designers, problem solving and learning from experience become central education processes although situated learning is not the same as learning by doing (see Buser & Koch, 2012, p. 257). The aim of design education is to develop a set of professionals with adaptive work characteristics, who are able to tackle any problem by drawing on their specific knowledge and working in a group. Thus, professional designers "have to learn to understand problems that other people may find it hard to describe and create good solutions for them" (Lawson, 2006, p. 5), and design for other people rather than themselves. They then become actors in roles leading to innovation and incremental changes in business and society.

To foster belongingness in communities of practice, educators play a pivotal role in integrating people by exploring and leading participation to the full. This links to a concern about allowing informal educators to fulfil the mentoring role for the sake of community association and engagement. The goal of education should be to develop the ability to design and to build a mind-set of perseverance and values compatible with the community. Furthermore, since the field of design is constantly changing, the values within the community are also changing, requiring PI development to keep abreast of these changes.

2.5 Reflection on and synthesis of theory

PI is a psychological process of identification within a professional practice and comprises self-perception and social-perception of professionalism (see Chapter 2, section 2.1). Both aspects develop symbiotically in a life-long learning process (Skorikov & Vondracek, 2011). However, comprehensive study of professional identity requires investigation of the internal and external aspects to this process, i.e., those constructs that are within or outside the personal realm.

Internal aspects are influenced directly by the environment, the context and the established community values (see Chapter 2, section 2.1). Thus, the education process and the development of expertise promote the emergence of characteristics and abilities required for mastery the practice. Integration and active interaction within the community foster learning and the consolidation of a professional identity and knowledge (see Chapter 2, section 2.3). Self-perception is an aspect of several loops of negotiation with the external world, the mind-set developed and the capacity for self-evaluation and regulation.

External aspects are established inside the professional group and dictate the values and requirements of its members (see Chapter 2, section 2.1). The function of professional design education is to kick-start the alignment between these values and meanings and technical training (Murphy et al., 2015). External aspects emerge over time culminating in consolidation of a professional identity based on social development and the network construction (Jensen & Jetten, 2016). Social-perception refers to the validation of the expertise development process through a positively stereotyped social identity.

Social-perception and self-perception, and the processes of identification and expertise development, start to evolve with engagement in the practice of professional knowledge (see Chapter 2, section 2.3). However, at the interface of these aspects is social inclusion in a community of practice, which plays a fundamental role in the construction of identity and the sense of belongingness (Wenger, 1998). Integration in a practice group fosters the learning process towards solid alignment to community values and expectations, which can be more important for identity formation than academic knowledge and training (see Chapter 2, section 2.1).

Social-perception and the constructs of professionalism are milestones in the journey to self-understanding and professional identity (see Chapter 2, section 2.1). This highlights the importance of the education system and expertise development in the process of identification. Thus, what is understood socially as fundamental aspects of design practice are a first step towards understanding the identity formation process. Also, social perceptions of professionalism form goals and expectations related to professional development, driving the negotiation between learning, uncertainty, belongingness, and self- and social-acceptance (Skorikov & Vondracek, 2011). Thus, the study of PI in design draws on work in psychology, design expertise, and other knowledge (see Chapter 2.2). In this way, the study of the professional designer raises synergies among several fields of study such as education, psychology and management and with industry.

The non-static nature of identity (Ahlgren & Tett, 2010; Baumeister & Muraven, 1996), highlights three issues in relation to the design literature. First, the need to combine the multidisciplinary aspects of design with the different specific focus areas encountered during design work in order to describe the personality attributes associated to design competencies. Second, the discussion of identity in design, which has been tackled by other authors in work on competencies/skills improvements (e.g., Crain, et al., 1995; Yang, You, & Chen, 2005), but not considered holistically as designer self-development. We need to consider these aspects together within a single cohesive framework. Third, since learning is a holistic process of adaptation to the world and not just the result of cognition (Ibarra, 1999), there is a need for an integrated understanding of the way an individual thinks, feels, perceives and behaves (Adams et al., 2011; Kolb & Kolb, 2005). Investigation of these challenges is the main focus and contribution of this thesis research. They are examined by combining DPI elements from disparate descriptions in the design literature (Chapter 4), by evaluating the relation of DPI to

the designer's role and expertise development (Chapter 5), and by evaluating differences in the perceptions of the social actors involved in designers' professional development (Chapter 6).

Finally, in this thesis, the term "designer" refers to **design practitioners with formal design engineering educations or in ongoing process**. This definition came to be as a reflex of the sample used within this thesis - mainly from design engineering education, and taking account that context and community of practice play a major role in professional identification (Baumeister & Muraven, 1996; Murphy et al., 2015; Wenger, 1998a).

3. Research Approach and Methodologies

This chapter describes the research methodology used to examine the three main research questions:

RQ1) What are the elements comprising DPI?
RQ2) How does DPI develop at different stages in a designer's career?
RQ3) What are the social- and self-perceptions related to the designer's role and the DPI?

To obtain and understanding of the theoretical foundations , characteristics and development of DPI, this thesis focuses first on the theory (Eisenhardt, 1989; Friedman, 2003) underlying empirical research on this topic. Theory is the set of rules that explain the behaviour of a system based on the causal relationships between constructs that predict system behaviour in various circumstances. Theory building requires the identification of relevant constructs, interaction principles, variables, explanations and testable predictions (Dubin, 2002). Whetten (1989) suggests that theory should provide the answers to four questions to define the phenomena it explains:

1. What constructs are needed to explain a given phenomenon?
2. How are these constructs related?
3. Why are these constructs expected to behave as posited by the theory? What underlying dynamics of the interaction are likely to be manifested in the expected behaviour?
4. What are the boundaries to the expected interactions, and can be expected to happen or not to happen between constructs?

This theory-driven research is underpinned by a theory building/testing cycle, which involves a process of exploration, theory creation and systematization, and empirical scrutiny and refinement as suggested by Cash (2018). The choices regarding data collection throughout this thesis relies on methods specifically designed for the contributions that constitute Chapters 4, 5 and 6. These core chapters were designed as separate studies that developed progressively. Each of them adopts a qualitative approach and three methodological steps: a) Research Clarification, b) Data Collection; and c) Qualitative Data Analysis. Research clarification provides a basic understanding of the relevant primary concepts. We identify the fundamental elements of DPI based on a review of the literature, as suggested by Blessing & Chakrabarti (2009). This provides the foundation for the studies in Chapters 4, 5 and 6. Here we outline the methodological steps and describe the overall research framework before, during and after data collection. Further details on the methodology applied in each phase are provided in the corresponding chapters. Table 2 presents the relation between the research questions, the methods used and the thesis structure.

Table 2. Relations between thesis structure and adopted methodologies

Research Questions	*Method*	*Research Approach for DPI aspects*	*Characteristic of the study*	*Thesis Structure*
i)	Mapping of concepts	Social-perception	Descriptive (qualitative)	Chapter 4
ii)	Design Engineers Survey	Self-perception and self-identification	Cross-sectional (qualitative & quantitative)	Chapter 5
iii)	Semi-structured interviews	Social- and self-perception	Comparative (qualitative)	Chapter 6

Given the sparse literature on the subject of DPI development, specific studies were designed to provide a deeper understanding of the phenomena. As a first step, desired and required characteristics for a professional designer were identified from the literature as DPI elements. They fall into two main categories: PA and DS. The description and discussion of these elements and their relation to the development of a PI, are presented in Chapter 4—DPI: Personal Attributes and Design Skills. These elements provide the basis also for Chapter 5—DPI: Education, Awareness, Expectation, Motivation, and Chapter 6— Social- and Self-perceptions about DPI. The perceptions of the described elements promote PI development (social- and self-perception) and the relations between development and awareness of PA and DS within a progressive process of acquisition of expertise and self-identification as a professional.

The chosen data collection and data analysis methods follow a logical sequence in addressing the research questions and fill some gaps in the literature. The data collections methods include: administration of a cross-sectional survey, to clarify the development of the elements derived from the literature over time; a set of semi-structured interviews, to evaluate the differences in perceptions and mind-sets surrounding this development. Both methods use comparative analysis and focus on the descriptions and explanations of similarities and differences in conditions and outcomes (Smelser, 2003). In the study based on the survey, we provide a cross-sectional comparison involving three groups of designers with different levels of professional expertise: (1) designers at the beginning of their design education, (2) designers at the end of their design education, and (3) professional designers. Cross-sectional research (i.e., based on completion of a survey by a single respondent at a single point in time) is the most appropriate for studies that examine concrete and externally-oriented constructs, sample highly-educated respondents, employ a diverse array of measurement formats and scales, and are either descriptive or strongly rooted in theory (Rindfleisch et al., 2008).

In the interview based study, we compared different actors involved in the construction and practice of design professionalism: professional designers, design managers, and design professors. Interviews are effective for collecting data when the interest is in understanding participants' perceptions or how the respondent came to attach certain meanings to phenomena or events (Taylor, Bogdan, & DeVault, 2016). Semi-structured interviews typically involve a number of pre-determined questions that are posed to each interviewee systematically and consistently, but that allow freedom to digress in order to obtain more detailed responses than from direct answers to standardized questions (Berg, 2004).

Table 3 illustrated the progression of the studies on the Theory Building steps based on decision points (assessment of previous study and further needs). The decision points constitute a stage of evaluation of the previous study regarding the maturity of theory and the estimation of required next steps within the Theory Building Framework (Cash, 2018). For example, after the study 1 (presented in Chapter 4), the definitions of DPI elements from literature were assessed as providing sufficient knowledge and structure that allow further empirical study. Thus, the needs for further development were evaluated and composed the draft of Study 2. The same evaluation process have occurred at the end of Study 2 (presented in Chapter 5). Three empirical studies have been published in the form of conference papers (see Annex 1-3), and refer to initial assessments of the Study 1and 2.

Table 3. Decision Tree of thesis studies

	STUDY 1	DECISION POINT 1	STUDY 2	DECISION POINT 2	STUDY 3
THESIS STRUCTURE	**Chapter 4**		**Chapter 5**		**Chapter 6**
THEORY BUILDING STEP	- Definition of DPI variables and limitation domain - Relationship building between DPI variables	**Assessment:** **Sufficient knowledge from literature**	4) Prediction, testing, and validation of the theoretical insights in design practice and create understanding how DPI develops over time.	**Refinement:** **Clarification of variables** **New study for 3)**	- Creating an understanding of the relations between DPI elements - Revision of defined variables
APPROACH	Analytical Theory Building procedure (conceptual)		Empirical Theory Building procedure (Statistical Sampling)		Empirical Theory Building procedure (Case Study)
METHOD	Qualitative: Systematized Literature Review	**Need: estimate development over time**	Qualitative and Quantitative: Survey	**Need: in-depth understanding of context and social-perception**	Qualitative: Interviews
AIM	Identification of contributing elements to DPI from literature		Understanding DPI development over time from Education, Awareness, Expectation, Motivation		Understanding differences in self- and social-perception
GOAL	To understand social-perception (from academics) regarding the designer and their identity development		To understand the patterns, motivations and expectations of DPI elements and career within each sampled group		To understand the differences in social- and self-perception, as well in regards to the elements from literature
OUTCOME	List of DPI elements as PA and DS Model 1 of DPI development	**Need: test the application of model 1**	Comparison of groups regarding DPI development over time Model 2 of DPI development	**Need: Revision of DPI elements from self- and social-perceptions**	Comparison of social- and self-perceptions Revised model of DPI development
PUBLISHED ASSESSMENTS	Design 2016		ICED 2017/ Design 2018		-

3.1 Thesis structure and phenomenological connections

This thesis is comprised of a series of papers. Paper-based theses consist of a collection of studies formatted as individual "publishable quality" papers, which, in this case, constitute three core chapters of the thesis. These chapters explore topics related to both social- and self-perception, the two main constitutive aspects of PI, based on the DPI elements of PA and DS. The studies follow a logical sequence of development: identification of the elements of DPI in the literature; their evaluation in relation to education, awareness, motivation and expectations; and the differences between self- and social-perceptions in the development of the professional designer. Figure 1 depicts the phenomenological connections between the areas of study and the relevant thesis chapters.

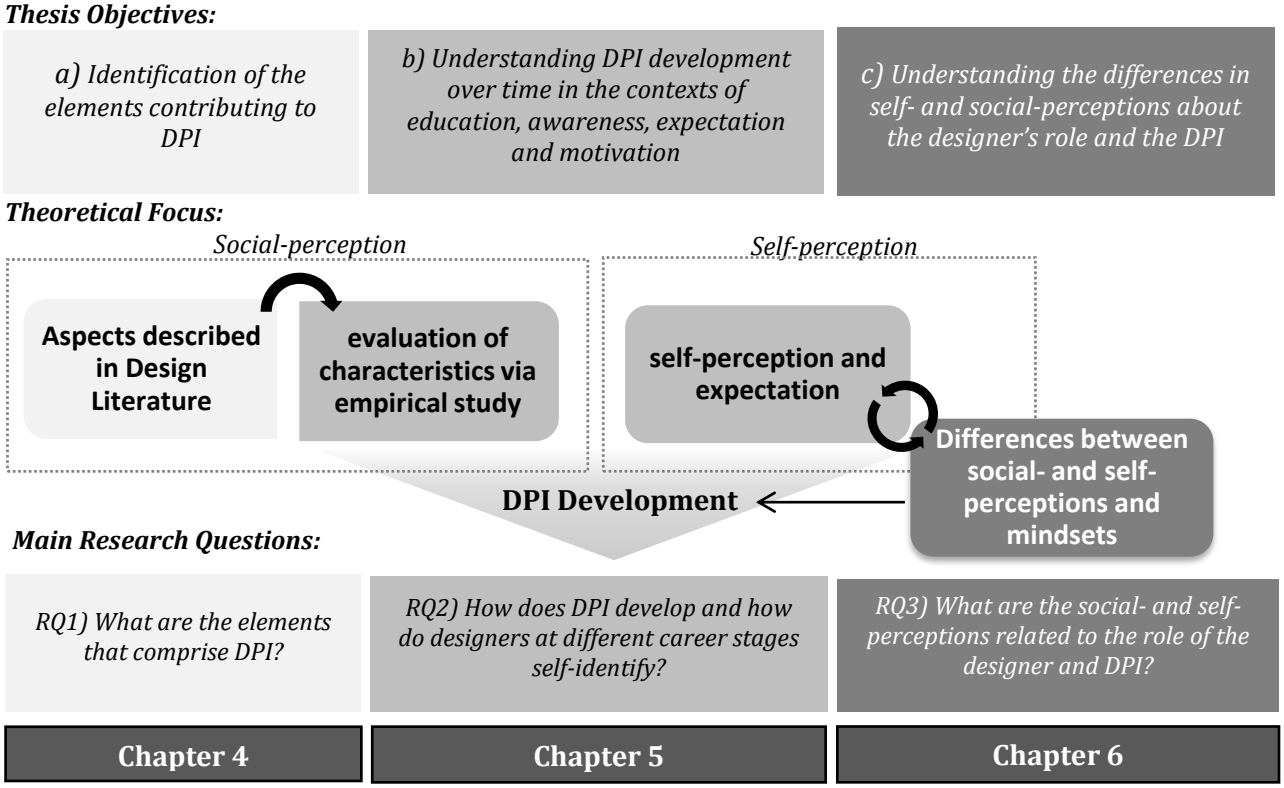

Figure 1. Areas of study within thesis structure

In each study, the main goal of the research approach and the theory are explained, the research questions are formulated and the chosen methodology is described. The thesis is structured in eight chapters: 1) Introduction, 2) Research Approach and Methodologies, 3) DPI: PA and DS, 4) DPI development through the alignment of self-perception and expectations, 5) Social- and Self-perceptions about DPI, 6) Discussion of contributions, 7) Limitations and further research, 8) Implications and Conclusions. Three of the chapters present specific studies and provide: a description and discussion of the elements synthesized from the literature as PA and DS (Chapter 4), the development of DPI over time (Chapter 5), and the differences in actors' perceptions (Chapter 6). The relations between the chapters and further insights are discussed in Chapter 6.

4. Study 1- Designers' Professional Identity: Personal Attributes and Design Skills

Designers' Professional Identity (DPI) is an essential aspect of professional development since it assigns responsibilities, values, behaviour and roles. The aspects that affect DPI, also affect individual social- and self-understanding as a professional designer. The aspects essential to a designer were synthesized from literature and comprise: Personal Attributes (PA) and Design Skills (DS). These two sets of elements are presented in terms of meaning, possible relations between them and their influence on the development of professional identity as described in the literature. The interrelations between PA and DS are proposed as a framework for the development of DPI, taking account of social- and self-perception aspects within a context. Several possible directions for future research are discussed. This study contributes to the design field by bringing together several elements and aspects related to professionalism that discussed separately and scarcely in the design literature, in order to propose a holistic understanding of DPI.

Keywords: ***Professional Identity,*** *Psychology of Design, Design Activity, Design Research, Human Factors*

Professional Identity (PI) is dynamic social- and self-understanding of someone as a professional e.g., as a designer, based on a context-related awareness and reflection on competencies, responsibilities, actions, beliefs and values through the synthesis of knowledge (see Chapter 2, section 2.5). Thus, PI usually is understood as the outcome of a merger between Personal Attributes (PA), i.e., individual characteristics, and Design Skills (DS), i.e., work attributions such as work demands and competencies (Bothma et al., 2015). In this sense, the process of developing a PI involves translation of individual conscious awareness as a worker (Skorikov & Vondracek, 2011) and can be seen as a complementary and parallel process to expertise development. It represents a complex structure of meanings, which relate individual motivations and competencies to acceptable professional roles, and frequently is conceptualized as a major component of someone's overall sense of identity (Chapter 2, section 2.1).

The development of a PI is considered an essential aspect of any profession (Bothma et al., 2015; Marquardt et al., 2016; Skorikov & Vondracek, 2011) including design (Fisher, 1997). At the individual level, a designer must be able to understand his or her roles and responsibilities and gain satisfaction and pride from representing the profession and in the chosen field (Woo, 2014). At the social level, a designer requires recognition as a designer, earned through the fulfilment of the requirements of professional peers and society (Schwier et al., 2004; Wang & Ilhan, 2009). It requires not only the acquisition of expertise and design skills but also professional ways of being (Dall'Alba, 2009).

Studies of design expertise address the development of professional aspects, focusing mainly on the cognitive and physical capabilities of design experts, by studying exceptional performance to distil the criteria for expertise or to make comparisons (Chi, 2006) between designers and non-designers (Christiaans & Dorst, 1992; Kavakli & Gero, 2002) and between novices and experts (Cross, 1990). Other work shows that personal and social factors and the contextual situation, also strongly influence professional development and PI (Baumeister & Muraven, 1996; Smith, 2015b). In the case especially of designers, due to the nature of the profession, their competencies, i.e., PA and DS, are closely related

and, together, provide the designer's social- and self-understanding as a professional. Lawson and Dorst (2009, p. 270) question the tendency to shape the profession as a set of skills and suggest the need for a learning and design thinking perspective that would allow novices and experts to be distinguished by self description rather than only through their practice:

> …designing is not just something you do, or that you take lightly when you practice it, but rather it helps form your identity… design becomes a part of one's being because it involves so much that is personal, like your creativity, way of approaching the world's problems, your own history, learning style and view of the world.

Overall, descriptions of the elements that constitute and influence PI development in design are dispersed in the literature and there is no cohesive framework to explain and study the phenomena holistically. Hence, we need an identification and description of the elements identified in the literature as core to design professionalism. Also, the process involved in the development of PI and self-recognition based on the described elements, would allow a better understanding of what constitutes the Designers' Professional Identity (DPI) (see Chapter 2, section 2.2).

The research in this chapter is aimed at providing an understanding of designers' characteristics by revealing the elements that comprise DPI identified from the literature, and describing their relations to identity construction. This is accomplished via a structured review of the design literature and a synthesis of the fragmented descriptions into structured sets of elements and a cohesive framework. To understand DPI and its development, this study builds a theoretical background based on knowledge from psychology (e.g., Bothma et al., 2015; Skorikov & Vondracek, 2011). The specific design literature is used in the discussion of the identified aspects of PI in a professional design context (e.g., Adams et al., 2011; Dall'Alba, 2009; Tracey & Hutchinson, 2016), while work in other fields such as human resources and nursing is used to enrich the topic (e.g., Dobrow & Higgins, 2005; Öhlén & Segesten, 1998).

By bringing together several aspects that are fragmented in the design literature, this work adds to the discussion of professionalism (e.g., Jørgensen & Brodersen, 2016) and professional development in design (e.g., Markes, 2006; Paton & Dorst, 2011). This study addresses the following research questions (RQ): 1) What does the design literature identify as essential aspects for a designer?; 2) How do PA and DS elements constitute a framework to foster DPI?; 3) How does this framework contribute to discussion of DPI?

This chapter is organized in sub-sections as follows: the methodology adopted (section 4.1); the elements synthesized from the literature as PA (section 4.2) and DS (section 4.3); construction of a DPI development framework (section 4.4); and conclusions and suggestions for further work (section 4.5).

4.1 Methodology

To construct a holistic framework for DPI, we examined what the literature identifies as *essential elements for a designer in order to develop DPI?*. The term *designer* in this thesis is understood as described in Chapter 2, section 2.5. The methodology includes four main steps (Figure 2): (1) initial identification of the PA and DS elements, (2) refinement and referencing of the PA and DS elements, (3) building a DPI framework based on PA and DS elements, and (4) supporting literature. Steps 2 and 3 constitute the core analysis and contribution of this work.

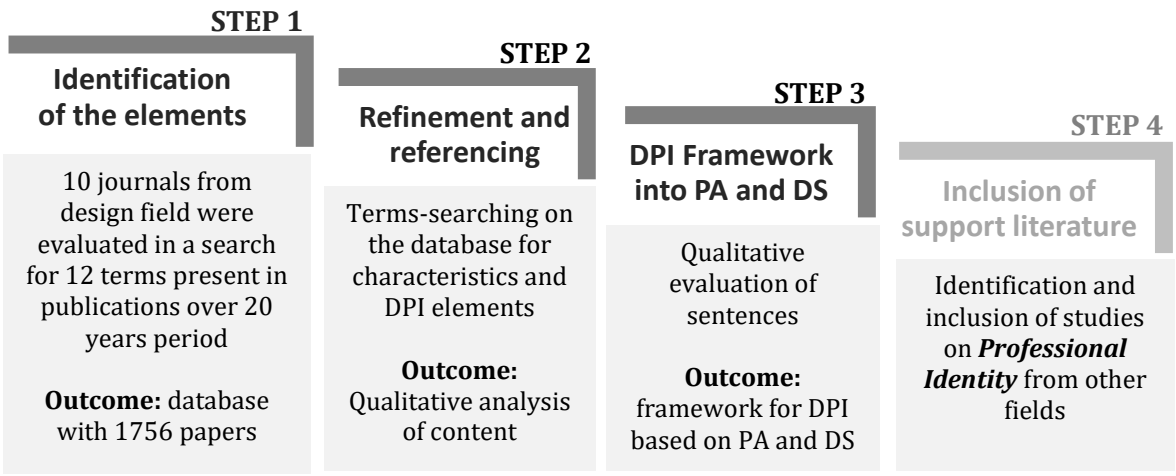

Figure 2. Methodological stages of literature acquisition, analysis, and management

In the first step, an initial identification of the elements was conducted by searching on titles, keywords and abstract of articles published in ten major design journals during the period of 1996-2016. Based on the narrative overview of PI in Chapter 2, the following 12 terms (words and expressions) were selected as indicating a general PI discussion and, thus, are used as a starting point: “Identity”, “Self”, "Self-Construal", “Self-development", “Personality”, "Learning Process", “Profession*”, “Expertise”, “Responsibilities”, “Competenc*”, “Skills”, and “Tasks”.

The selected journals were chosen to cover the diversity of approaches in the field and include both the most representative and most specialized and theoretical journals. The search in this first step resulted in a total of 1,756 peer-reviewed articles which are listed in Appendix 1 (section 4.7.1), according to their respective journal. The articles were recorded in a database and are used for the qualitative discussions in this chapter whenever relevant. A preliminary study round was conducted using this method applied to one major journal in design field (see Kunrath, Cash, & Li-Ying, 2016 - Annex 1).

In the second step, a refinement procedure was applied to the articles collected in the first step, using a term-searching technique and qualitative analysis of sentences in order to map descriptions of the *essential aspects for a designer* and DPI elements in the text. Kleinsmann et al. (2017) used a similar procedure. Thus, the qualitative evaluation began with identifying entire sentences and paragraphs in each selected publication where authors specifically described certain aspects as important or required for designers and design activity. Table 4 presents three examples of the sentences collected from the literature and evaluated as describing *essential elements for a designer*.

The analysis of sentences showed that different terms were used to describe similar aspects. We identified 40 terms used to describe similar characteristics, and these terms were searched in order to map possible missing sentences in the literature and cover differences in terminology. A term-search was applied to the articles collected on step 1. The list of terms and the articles containing these terms is provided in Appendix 1 (section 4.7.2). The number of articles citing a specific term can be considered a measure of the amount of discussion and the use of the terminology dedicated to that specific aspect of the design profession and its significance in the design field. However, this score is not considered a measure of its importance in the context of identity formation.

Table 4. Examples of sentences from literature that describe *essential aspects for a designer*

"Designers should act as problem solvers who have a full set of responsibilities and roles in order to suggest solutions to non-definitive problems." (Tam, Au, & Taylor, 2008)
"The key talent of designers is having deep empathy for the people they design for. They understand how people experience products, services and environments now, and have understanding of the contexts in which new design visions will live." (Crossley, 2003)
"The impact of groups outside the year group may have had an impact on the idea that 'good' drawing is an important designerly skill. Teachers in schools and society at large may tend to categorize those who can draw as being potential designers." (Ashton & Durling, 2000)

In a third step, the data on the described *essential elements of a designer* were categorized as either related to PA or DS, and assigned to subcategories based on discourse similarity. The DPI elements framework was developed qualitatively based on a synthesis of the literature and the merging of terminologies with similar meaning obtained from the mapping of sentences describing *essential elements for a designer*. It takes account, also, of the list of 40 terms developed in the previous step and the preliminary framework derived from the preliminary study round (see Kunrath, Cash, & Li-Ying, 2016 - Annex 1). Thus, the final list of DPI elements presented in the Chapter 4, sections 4.2 and 4.3 and the articles containing relevant sentences were incorporated as references in the description of elements. The authors also manually allocated the sentences and articles collected in step 1 to the DPI elements in the PA and DS categories, while sentences describing the interrelations between these elements were extracted during this process. An example of the method used to evaluate the sentences is provided in Appendix 1 (section 4.7.3).

Finally, we drew on the broader and more developed body of knowledge from the fields of psychology and management. This secondary narrative review was based on cross-referencing and generic non-systematic research to provide further insights into PI and professionalism approaches. This other literature was used to supplement the design literature, which lacks specific theory about PI in a design context.

4.2 DPI elements: Personal Attributes (PA)

PA describe the characteristics related psychological aspects such as thinking, emotions and feelings, attitudes and behaviours. The elements in this group are not technically related to design, but rather to the socio-psychological aspects and values-based comfort felt internally (Tam et al., 2008) and externally expressed by *being a designer,* and the relation between mind and body, i.e., attitude (Dall'Alba, 2009).

Since the designer involuntarily uses his or her personal experience and perception as resources to synthesize and shape design outcomes (Pedgley, 2007), understanding the elements that comprising the PA *(human lens)* of DPI is key to understanding behaviour and decisions during the design process (Adams et al., 2011). These attributes are based on internal values and constructs and affect the individual designer's view of himself or herself as a professional, based on personal expectations, environment and career development (Skorikov & Vondracek, 2011). PA are the filter for the personal repertoire and desires and their thinking, acting and being as a designer. Table 5 presents the PA

elements derived from the design literature identified as essential aspects for designers. The number of publications associated to each element is presented in Appendix (section 4.7.2).

Overall shared characteristics of all Personal Attributes:

- Relates to personality and personal behavioural approach.
- Rely on temporal consistency, changing very slowly and gradually over time.
- Refers to personal aspects such character, values and their expression.

Table 5. Personal Attributes and descriptions

Elements from Literature	Description
Confidence	*Certitude of its own personal abilities and professional competencies, being able to embrace innovative ideas and to start challenging projects, justifying own beliefs and (ethical) work.*
Creativity	*Spontaneous impulse to solve problems originated from an interaction with an individual psyche and manifest as behaviour.*
Emotions	*Sensitivity to external inputs, self-awareness, and management of personal feelings, also related with moral and empathetic aspects.*
Empathy	*Psychological capacity to identify yourself with other's feelings and thinking, which enables to act towards help and supportive behaviour.*
Ethics	*Awareness and positioning about any possible environmental, social, health or design life performative consequences, or lack of compliance to legislation.*
Leadership	*Sense of autonomy and managerial attitude, searching and promoting ideas among strategy and business view together with peers guidance and inspiration.*
Motivation	*Engagement in an activity due to an inner perception of enjoyability and inherent interest (intrinsic motivation), as well as because of its association with a value outcome (extrinsic motivation). Also, refers to one's curiosity and impetus for exploring and searching.*
Openness	*Acceptance and embracement of new and unusual ideas or methods, being able to deal with uncertainty and to make changes on the work plan by relying on the ability to improvise and remake. Also refers to capacity to deal with different topics and to work with people from different cultures, ideologies or beliefs.*
Responsibility	*Willingness to learn and to assume responsibilities from mistakes, conscientiously assuming risks, taking care of project details, deadlines, and working within own beliefs.*
Social Abilities	*Perceived facility on the exchange of tacit knowledge via joint activities: being together, living in the same environment, sharing experiences, and transferring ideas to other people.*

4.2.1 Confidence

Confidence can be understood as a sense of personal trust that allows for exploitation of innovative ideas and tackling of challenging projects, and justifies the individuals beliefs and work decisions. Confidence is related to PI and is a subjective feeling of competence, influenced by individual differences such as decisions about ethics and personal beliefs (Iacobucci et al., 2012).

This personal attribute has been described in the literature as certitude about one's personal abilities (self-confidence) or certitude about professional competencies (professional confidence). NEDO (1993) suggests that self-confidence provide a competency model for designers, which describes the qualities that a 'good' designer ideally should pursue (Bruce et al., 1999). However, confidence in one's personal and professional abilities involves consideration of several inhibiting factors such as social, personal, intellectual, skill, situational, technological and comparative elements (Booth et al., 2016).

Confidence develops in PI with the acquisition of knowledge and experience and promotes development on the personal, relationship and collective levels (Rowlands, 1995). However, greater design expertise is not necessarily indicative of greater confidence especially under uncertainty conditions (Zhang, 2015). Thus, supportive work and an educational atmosphere that fosters empowerment could speed the acquisition of skills (Stoner, 2009); Fraher & Martinson (2011) refer to a connection between student's confidence and motivation for participation in a design project.

4.2.2 Creativity

Creativity can be understood as the spontaneous impulse to solve a design problem, originating in an interaction with the individual's psyche and manifested as behaviour. Creativity is related to the designer's professional identity as a fundamental ability that both identifies and stereotypes the designer, and shapes individual understanding of self as "creative" (Fisher, 1997).

This personal attribute is considered in the literature as an individual competency, which has significant effects on the quality of a design solution (Kim et al., 2011). However, although creativity is a desirable design characteristic and good designers usually are creative thinkers, it is not a necessary or unique condition for design (Alexiou et al. 2009). Thus, the relationship between design and creativity moves from the creative individual to the collective (Dantec, 2016). Steen (2013) describes cooperative creativity as, rather than a focus on the individual, a process of joint idea generation. The capacity to combine ideas collectively and realize them, combined with other attributes that foster collaboration e.g., Openness, highlight another facet of designer creativity based on collective creative practice (Bowen et al., 2016).

Creativity develops in PI as part of a continual self-reflexive monitoring embedded in the shared knowledge derived from social interactions and a non-individualistic approach (Elkjaer & Brandi, 2014; Fisher, 1997). Designers exploit the connection between pre-existing thoughts, feelings, images and memories through an unexpected relationship (Chandrasekera et al., 2013), and the interaction among each of these components of the psyche, to produce different forms of creativity (Hillman, 1972; Wilde & Labno, 2001). Thus, individual creativity can be seen as a unique capability, associated strongly to personality traits, personal cognitive preferences and flexibility, social abilities and the characteristics of the design process (Simonton, 2012; Wilde & Labno, 2001).

4.2.3 Emotions

Emotions can be understood as an internal process of reflection on a situation and a desirable designer characteristic. Emotional intelligence can be considered as the ability to perceive, control and regulate one's own and perceive others' emotions (Grewal et al., 2006). This attribute relates to PI as a response to reflection on designers' sensitivity to external inputs, i.e., self-awareness and management of personal feelings, and is linked to moral and empathetic aspects (Tracey & Hutchinson, 2015).

The literature describes this PA as 'affect' structured on background experience, and a 'feeling' of awareness and knowledge about affect (Tomkins, 2008). Affect is described as an intensive vibration, a primordial and innate ability of the body to respond to external stimuli (Deleuze & Guattari, 1987). Massumi (1995) considers these attributes to be internal and personal and to describe the quality of an experience based on subjective content. Thus, emotions can be understood as the labelling (linguistic definition) of an affective state to facilitate public expression of feelings, to communicate our affective state to others, to fulfil social obligations or to negotiate interpersonal relations (Dong, 2009). The affective state emerges from consideration of previously encountered situations related to design work and design practice (Dong, 2009). Those endowed with high levels of emotional intelligence are attractive as team members due to their awareness and control (Jordan & Lawrence, 2009), ability to think about and express their feelings (Haviland & Reise, 1996; Taylor & Bagby, 2000), and their ability to form better personal relationships and tendency for optimism (Goleman, 1995).

Emotions develop in PI as a response to understanding and transforming the self (Tracey & Hutchinson, 2015), which influences how the designer deals with divergent situations, makes sense of uncertain situations, and brings understanding to knowledge-in-action through reflection-in/on-action as a way of thinking (Schön, 1983). The intensity of an emotional experience, the frequency of emotional change and how designer's understand and control their emotions are individual differences that can be both positive and negative in their effect on behaviour and its consequences (Funder, 2013). The expression of emotion depends on significant internal (evaluative) and external (conditioning) components such as cognitive capacity, individual background knowledge, relation between experience and biological (body) response and context (Dong, 2009).

4.2.4 Empathy

Empathy can be understood as the psychological capacity to self-identify with another, enabling helpful and supportive behaviour. Empathy is related to cognition, affectiveness and behaviour of the self towards the other's thinking and feeling (Hess & Fila, 2016). Along with social responsibility and moral reasoning, it is related to PI as someone with an altruistic personality. In this way, other-oriented tendencies or traits motivate pro-social behaviours and mitigate anti-social behaviours, which constitutes a so called *Moral Identity* i.e., people that have morality as central to their sense of identity (Hardy & Carlo, 2011).

This type of PA is usually discussed in the context of users (user-centred design) and the target audience. Studies of user-centred design discuss empathy as a quality of the design process that is influenced by the designer's individual ability and willingness (Kouprie & Visser, 2009). Empathic design embodies an attempt to understand user demands and lifestyles to increase the likelihood that products and services will be fit for purpose, satisfy demand and enhance users' lives and experience

(Mattelmäki et al., 2014; van Rijn et al., 2011). In this sense, empathy can be seen as necessary for the development of products that meet real customer needs. To foster this trait, several techniques can be applied to strengthen ties and create an immersive understanding of the situations of clients or groups. However, since empathy is also an internal process, the success of these techniques might depend on individual capabilities related to psychological aspects, e.g., narcissism and self-awareness (Dimaggio et al., 2008).

Empathy develops in designers' PI as enhanced empathic understanding of users; it varies among individuals and increases over time through training and experience (van Rijn et al., 2011). As a designer's PA , empathy is derives mainly from previous individual experience, which sets an 'empathic horizon', i.e., set the limits to the designer's capacity to empathize beyond the characteristics of group belonging such as nationality, background, age, gender, culture, experience and education (McDonagh-Philp & Denton, 1999). For the designer involved in a project, the level of engagement with that project and the user group, and other contextual and personal factors, determine the designer's willingness and motivation (Kouprie & Visser, 2009) or 'empathy quotient', i.e., level of empathy that can be achieved (Baron-Cohen & Wheelwright, 2004).

4.2.5 Ethics

Ethics can be understood as awareness and attitude to possible performative consequences (environmental, social, health, design) of a project and compliance with the legislation. It is related to PI as a self-regulatory core element of reasoning and behavioural standards (Minnameier, 2014), based on personal and professional values and attributions of work identity and engagement (Eteläpelto et al., 2014).

This PA is discussed in the literature in terms of professional understanding and responsibility for project outcomes, and how engineering solutions affect users and society in general (Cañavate et al. 2015). Values in engineering are related, mainly, to ethics and both values and ethics figure in discussions about liability, legal responsibility, etc. Some of these concerns have been recognized by the Engineering Associations that publish engineering codes and regulations for engineering practice. Nevertheless, as George Catalano (2006) shows, the focus is mainly on reliability and integrity in relation to work practice. Thus, morality and ethics tend to be considered in terms of right or wrong personal actions and traditional ethics (whether certain actions and behaviour are allowed, required or recommended). Yamun Nahar et al. (2009) highlight out, in most cases, engineering programmes are limited to micro-ethics and topics such as whistleblowing or individual concerns, rather than macro-level collective ethics (Herkert et al., 2015).

Ethics develops in PI as a functionalist design practice that provides directives for designers' actions (Fry, 2006). Thus, the designer's personal identification is imbued in individual design ethics and the creation of value. Training in engineering ethics promotes development and exercise of "moral imagination", i.e., learning how critically to assess one's point of view and evaluate alternative courses of action by embracing multiple roles, schemes or mental models (Oosterlaken & van den Hoven, 2012; Steen, 2013a).

4.2.6 Leadership

Leadership can be understood as the sense of autonomy and managerial attitude arising from the mastery of abilities in diverse DS categories. Leadership is related to PI by its grounding in deeper cognitive structures such as personal identity metacognitive processes and emotional regulation, which promote leadership activities and coherent, self-relevant and authentic values (Lord & Hall, 2005).

Leadership is discussed in the literature under two main headings: task-focused leadership, i.e., related to task accomplishment, and person-focused leadership, i.e., facilitating team interaction and/or development (Burke et al., 2006). The leader's self-identity is unique and provides the structure needed to organize the relevant knowledge and motivation for direct engagement in developmental situations, and facilitates use of personal experience to understand and motivate subordinates. The capacity of the aggregation of skills and other aspects is in line with the description of agreeableness in psychology. An inverse relation is reported between impact of leadership and "sociability" i.e., a self- reported measure of enjoyment of being around people (Brunello & Schlotter, 2011). It has been suggested that leadership, in part, captures social skills and emotional intelligence (Kuhn & Weinberger, 2005). In design, leaders play a pivotal role in team performance by shaping the team's collective norms, helping them cope with their environment, coordinating collective action (Mehra et al., 2006), and managing personnel resources towards an enabling structure, i.e., designing the work to be meaningful, promoting core norms of conduct, and organizing team composition (Hackman, 2004).

Leadership emerges from problem-solving skill, i.e., the capability creatively to manage ill-structured problems, which is a critical aspect of leadership rather than a specific behavioural style (Mumford et al., 2000). Lord & Hall (2005) suggest that leadership performance embraces a progression from novice to expert skill levels, based on the development of information processing capabilities and the underlying knowledge structures. Through this progression, leaders develop the capacity to draw on internal resources such as identities, personal values and mental representations of subordinates and situations. Thus, in order to sustain interest over the time required to develop and practice complex leadership skills, the leadership role is likely to become embedded on individual self-identity allowing the leader's current psychological state (motivational or emotional) to influence access to knowledge.

4.2.7 Motivation

Motivation can be understood as the expression of engagement with the design task and inner perception of the enjoyability and inherent interest in the task (intrinsic motivation) and its association to a value outcome (extrinsic motivation) (Ryan & Deci, 2000; van Hooff & van Hooft, 2017). Motivation is related to PI since it deals with *morale* (Jagodzinski et al., 2000), which allows the individual to select among objectives based on self-interest, curiosity, care and abiding values (Wang & Hou, 2015).

This PA is depicted in the literature as one of ten critical designer competencies that have a direct impact on performance (Robinson et al., 2005). Studies of radical innovators suggest that curiosity, determination and passion for their work are the strongest work motivations (Hebda et al., 2012;

Marvel et al., 2007); Alexander & van Knippenberg, 2014). Curiosity is also a core competency for design engineers (Robinson et al., 2005) and is related to the impulse for exploring and searching.

Motivation develops in PI as an adaptive personality characteristic and acts to regulate internal and external triggers (van Hooff & van Hooft, 2017). For example, if the individual pursues interest, enjoyment, self-expression, satisfaction of curiosity or personal challenge, it can be assumed that he or she is intrinsically motivated. Similarly, individuals can be considered extrinsically motivated if their engagement in work is aimed at achieving some goal separate from the work itself (Amabile, 1993), i.e., achievement of a design goal or personal improvement, or fear of punishment and interest in rewards. However, in the case of traits that can be described as self-defeating, e.g., narcissism, rigidity, defensiveness (Skorikov & Vondracek, 2011), we find a negative association to motivation. An imbalance between motivation and identity indicates lack of alignment between values, expectations and the particular contextual situation or task.

4.2.8 Openness

Openness can be understood as the capacity to accept and embrace new and unusual ideas or methods (Reilly et al., 2002). It relates to PI in terms of its crucial role in adaptation to and development of one's identity structure. If the identity structure is well developed it is generally flexible and open to change except in specific situations when decision-making and behaviour are influenced by rooted values, external pressure or are mired in indecision (Bosma & Kunnen, 2001b). Thus, openness, among many other factors can serve to mediate external pressure in the process of identity formation, e.g., ego resilience, self-esteem and cognitive complexity.

This PA tends to be portrayed in the literature in terms of open-mindedness and capacity to deal with uncertainty or ambiguity, or flexibility. Individuals who are open display traits such as broad-mindedness, which is closely related to other PA e.g., creativity and motivation (Reilly et al., 2002), and a mind-set that favours collaboration based on the capacity to tackle different topics and work with people from different cultures, ideologies or beliefs. Due to the nature of design problems, the capacity to make changes to work plans and the ability to improvise and remake, are fundamental designer characteristics. Research indicates that the level of openness is a predictor of performance in radical innovation projects since it involves creative solutions to problems under conditions of high uncertainty. It has been suggested that openness becomes more important for more creative tasks (Reilly et al., 2002). Also, individuals who are very open to experience tend to have high levels of curiosity and interest in seeking others' ideas and insights (Wang & Noe, 2010), all of which foster collaboration. Cabrera et al. (2006) found that openness was related positively to individuals' self-reported knowledge exchange, however, Kichuk & Wiesner (1997) found no relation between openness and team performance.

Openness develops in PI as a psychological factor that can affect the relational and cognitive dimensions of social capital and learning (Marsick et al., 2014). In psychology, 'openness to experience' is the least well-defined of the so called 'big five' factors that constitute intellect (Kichuk & Wiesner, 1997). Intellect, in the sense of general intelligence or mental ability, is associated to traits such as imagination, culture, curiosity, originality, broad-mindedness, intelligence and artisticness (Barrick & Mount, 1991). Thus, although psychological factors are considered to be stable over time and related

to an internal change process (Bosma & Kunnen, 2001b), interaction and critical reflection seem to be effective for increasing openness to elements of PI development (Khalili, 2013).

4.2.9 Responsibility

Professional responsibility can be understood as the willingness to learn from and to assume responsibility for mistakes, conscientiously taking risk, and handling project details and deadlines. This attribute is related to PI as a criterion for the *Judgment of Responsibility* process (Hardy & Carlo, 2011), stems from the self and expresses moral identity, and influences the designer's individual decisions because of his or her assumed values and beliefs, social expectations and professional role.

This PA is discussed in the literature in terms of a sense of personal responsibility for outcomes which goes beyond formal qualification for the task at hand (Yang et al., 2005). It includes the designer's capacity to work according to personal beliefs. Thus, in design, personal and professional responsibility embraces ethical decision-making, sustainability and social responsibility. Spitz (2015) emphasizes that constructs such as social responsibility, are expressed in the idea of the moral dimension inherent in design. In this sense, the designer must contribute to a cultural response to the technologic civilization, i.e., to a positive impact on society through design. Thus, discussion of ethical and societal responsibility is related to whether "the designer is to aim at fulfilling the design brief in such a way that the items designed (products, services, structures, infrastructures, etc.) constitute cures (or parts thereof) to wider socio-political ills (or at least do not further entrench them)" (Christensen 2006, p. 135). This understanding can vary across and social standings, e.g., usefulness and level of responsibility of Design as a profession (Chung & Whitfield, 1999). Nevertheless, a sense of social responsibility in design is linked also to environmental concerns and the ways that designers contribute to a sustainable society. According to Manzini & Cullars (1992, p. 220), "the designer's ultimate responsibility can only be to contribute to the production of a habitable world" while this sense of responsibility and solidarity is directed towards present and future generations.

Responsibility develops in PI as the designer assume responsibility for his or her project and the related tasks, i.e., to ensure satisfaction of customer requirements and compliance with project specifications, to ensure costs are within budget and that product quality , including manufacture and assembly, are according to the project conditions (Swift, 1999). D'Anjou's (2011) proposed Sartrean model, links a sense of professional responsibility to the designer's freedom of choice during a project, to promote an ethical decision-making process. In this sense, the designer's personal ethical values and self-awareness, may lead to choices and assumption of responsibility in a project, i.e., ability to freely and authentically refuse or accept external demands while having freedom as a guide to any ethical judgment (d'Anjou, 2011).

4.2.10 Social Abilities

Social ability can be understood as the perceived facility for the exchange of tacit knowledge via joint activities: working together, sharing the same environment, sharing experience and transferring ideas to other people. This attribute relates to PI by highlighting the close relation between the professional and social identity, resulting from ongoing contact with the world of work (Cohen-Scali, 2003).

This PA is considered in the literature to be an activity fundamental to design work. Some authors describe design as essentially a "social ability" (Alexiou et al., 2009), i.e., a "social process" rather than a cognitive process, and consider that it is performed by individuals situated in a rich and dynamic social context and is not a mechanical process (Ball & Ormerod, 2000a; Bucciarelli, 1988). Some have portrayed design engineering as a highly social process, distinguishing between work that occurs in the object-world and in the social-world (Bucciarelli, 1994; Bucciarelli & Kuhn, 1997). The social-world refers to the interactions with others that occur while the designer is working (Robinson et al., 2005). In this sense, the design process involves a spectrum of social skills that enable the professional to exploit his or her ideas, negotiate a consensus and provide the lead (Lawson, 2005). The individuals' ability to cultivate networks and design or structure ideas, allows efficient idea implementation of innovations, which, in organizations, tend to be characterized as a social-political process (Baer, 2012).

Social abilities develop in PI based on the accumulation of expertise and skills, associated to experimentation by the professional (Cohen-Scali, 2003), and the construction of social recognition and a professional network (Dobrow & Higgins, 2005b). A professional with social abilities is described as welcoming, responsive and as having a sense of service (Jansson et al., 2015), which is fundamental to employability and the quality of the work environment. Thus, the ability to socialize is reflected in PI development as improved knowledge transfer and maintenance of a social identification (Evetts, 2003).

4.3 DPI elements: Design Skills (DS)

The elements classified as DS are those that comprise the set of skills necessary to develop a successful design process, but which are not related specifically to the designer. Rather, they are characteristics that can be acquired through training, education and practice.

All the areas of knowledge to which the DS elements contribute have been investigated in the design literature (see Appendix 1, section 4.7.2). They reflect the tendency for established design research to focus on the practical elements of product development and to develop models and tools to facilitate and increase work quality and designers' performance in the various project phases. Table 6 presents the DS elements derived from the design literature, categorized according to different knowledge areas. There are four main categories: Cognitive Skills, Communication Skills, Technical Skills and Management Skills. A similar categorization is provided in Krawczyk & Murphy (2012) and Kang et al. (2015). The sub categories within each of these main categories are based on the literature. Discussion at the sub category level contributes to a better understanding of that sub-area of knowledge rather than its quantification. The list of publications associated to each subcategory is provided in Appendix 1 (section 4.7.2).

Overall shared characteristics of all Design Skills:

- Describe cognitive, technical and behavioural characteristics related to design practice.
- Incorporate characteristics that can be directly trained through education and practice.
- Develops rapidly following formal learning processes.

Table 6. Design Skills and descriptions

Subcategory	Description
Cognitive Abilities	*Capacity of think 'designerly'; understanding the nature of the problem to be solved; developing a distinct way of thinking about the problem and solution spaces; demonstrating high level of abstraction for idea generation and evaluation rounds.*
Cognitive Strategies	*Ability to set strategies of learning, problem framing, solution development, and problem-solving that allows the flow of the cognitive abilities.*
Personal Communication	*Capacity to communicate clearly and directly, attending to details and empathizing with an audience.*
Interpersonal Communication	*Awareness of communication ability in order to make public presentations, set collaborations, establishing rapport, and to communicate among a team.*
Education-based Knowledge	*Awareness of basic and specialized knowledge in design that compounds the formal education, and domain of technical and design language.*
Practice-based Knowledge (know-how)	*Abilities based and developed through practice, expertise and know-how gain. Such as good imagination/ representation, IT competencies and use of software, negotiation capacity, and appliance of previous knowledge.*
Managerial Competency	*Perceived competency for managing generic tasks, in a personal level and with the colleagues or among the team.*
Project Management	*Competence in developing and managing the project such as planning, progressing among the tasks and phases, and evaluating effectiveness and outcomes.*

4.3.1 Cognitive Abilities

Cognitive abilities can be understood as a spectrum of competencies related to the designer's internal reasoning and mind-set. Cognitive abilities refer to a distinct way of thinking (Cross, 2001b; Evans, 2012), required by the multifaceted, ill-defined (Goel & Pirolli, 1992) and open-ended nature of design problems (Cross, 2004), which increases the complexity and effort involved in addressing such 'wicked problems' (Buchanan, 1992; Rittel & Webber, 1973).

This DS is described in the literature as the capacity of think in a 'designerly' way. (Dinar et al., 2016). In the design literature, cognitive abilities are understood as embedding the following elements: understanding the design problem (e.g., Lawson, 2005), designerly thinking (e.g., Cross, 1982; Oxman, 1999), capacity for abstraction (e.g., Oxman, 1990), and evaluative analysis (e.g., Khorshidi, Shah, & Woodward, 2016). These abilities allow the designer to understand the characteristics of the problem to be solved and set the notional problem space – based on the project requirements, and solution space – represented by the set of constructions that satisfy these requirements (Alexiou et al., 2009) while also handling the cyclical definition of the problem and the solution (Dorst & Cross, 2001; Dorst & Dijkhuis, 1995).

Cognitive abilities develop in PI as creative problem solving capacity, which requires simultaneous development of cognitive and domain-based skills, i.e., co-evolving with the solution (Dorst & Cross, 2001; Suwa et al., 2000) and affecting its quality (Chakrabarti et al., 2004; Walz et al. 1993). Thus, innovative thinking makes use of analogical reasoning that is based on memory and knowledge application related to previous problem-solving experience (schema-driven analogy) or to specific 'instances' of problems or situations (case-driven analogy) (Ball et al., 2004). Since the designer's first representation has a significant impact on subsequent project development (Björklund, 2013), this memory/knowledge built on previous experience, shapes thinking agility, solution generation, abstraction level and idea evaluation, and constitutes the construction of expertise over time.

4.3.2 Cognitive Strategies

Cognitive strategies can be understood as a spectrum of competencies that allow flows of the mental dynamics to solve a design problem. This can be in the form of a particular decision-making pattern on which basis design tasks are planned. Cognitive strategies are linked to the designer's PI and mental processes, where factors such as technical competency in methods and tools, domain knowledge, expertise combine with cognitive ability to control how the designer thinks (Dong, 2009).

This DS is described in the literature as constituted by : learning through design (Elkjaer & Brandi, 2014; Garner, 2005), problem framing (Cardoso et al., 2016; Cross, 2004), development of a problem solution (Fiorineschi et al., 2016; Kruger & Cross, 2006) and problem solving (Atuahene-gima, 2011; von der Weth, 1999). The dynamics of cognitive abilities lead the designer to adopt strategies that allow recurrent flows of elements throughout the project, according to a cyclical dynamics between problem and solution definition within design process. The first phase in clarifying the design task is, usually, defining the problem (Baxter, 1995), using the strategy of *Problem Framing* (Cross, 2004), to define the problem-solving task. Several authors suggest that successful problem framing is associated to expertise (Akin, 1990; Cross, 2004; Lawson & Dorst, 2009; Paton & Dorst, 2011). Also, use of structured, logical design process sequences or design project methodologies, can be considered as representing the designer's cognitive strategy to address the process of *problem solution* in an efficient and professional way (Cross, 2001a). Thus, divergent and convergent thinking are discussed by design methodologists as necessary for successful design, despite the focus on only convergent thinking in most design education (Cross, 2008).

Cognitive abilities develop in PI as patterns of design thinking and cognitive structures that influence the likelihood of the designer success and distinguish different levels of expertise (Dong, 2009). In psychology and education, cognitive strategy is on the border between personal ability and adopted strategy, and integrates learning style and personality type. Thus, the learning process can be used as a strategy to overcome inconsistencies and uncertainties while the designer searches actively for knowledge.

4.3.3 Personal Communication

Personal communication can be considered as a spectrum of competencies related to how designers communicate during the design process through their use of language and work presentation. This skill is related to the designer's PI since the language used - words and phrases – can have a regulatory

function and demonstrate the designer's personal commitment, autonomy in speaking and writing, and the situational and socio-cultural context of the communication event (Dong, 2009).

This DS has been defined in the literature as the capacity to communicate clearly and directly, attend to detail, and empathize with the audience. The interaction between the designer, his or her intentions in a speech, and his or her understanding of quality communication definitions from other influential designers, shape the narrative at team, project or corporation level and express personal experience, functional specifications of the design, negotiation within the process and resolutions (Baird et al., 2000; Peter, 2000). If the designers involved do not share a common mental representation of the narrative (Dong, 2009), individual thinking and reasoning styles will influence the capability to share knowledge (Mulet et al., 2016). Thus, the capacity for clear and direct communication relies on communication skills to allow a mutual understanding with the receptor (Robinson et al., 2005). Research shows that mistakes during the design process occur mainly as a result of misinterpretations and wrong assumptions, rather than communication failures per se (Busby, 2001).

Personal communication develops in PI through an alignment between individual attention to detail and empathy with the audience. Dong (2009) suggests using the "voice of a collective group", e.g., a school of design, positions of the stakeholders, reference to the design brief or programme, reference to the way others design, etc., to better reflect personal thinking. In this sense, the development of personal communication skills reinforces the importance of social abilities and understanding about work within the so-called social-world, i.e., the social interactions that occur while the designer is working (Robinson et al., 2005).

4.3.4 Interpersonal Communication

Interpersonal communication can be understood as a spectrum of competencies related to designer awareness of communication capability, which promote achievement of social cohesion through interactions and collaboration with colleagues and peers. It is related to DPI through its several contributions to professional and social understanding (Eteläpelto et al., 2014), in the epistemic dimension of design (perspectives, disciplinary knowledge), the social context (roles, responsibilities), inter-comprehension (communication, constructing understanding), and the design and creative processes (Détienne et al. , 2012). At the group level, collaborative skill contributes to the development of a superordinate identity, i.e., the degree to which team members identify with the team to which they belong, are committed to its overarching goals, and feel they have a stake in its success or failure (Mackie & Goethals, 1987; Sethi & Al., 2001).

This DS tends to be seen as the capacity to make public presentations, provide proper documentation of the work process, establish collaboration and communicate with the team and establish rapport. Aurisicchio et al. (2016) emphasize that interpersonal communication is a key resource for dealing with complex requests, resolving design problems in a practical way and learning how to design and establish social networks. Thus, in line with observational studies of designers in industry, it acknowledges the importance of social information transfer in critical and complex design situations (Badke-Schaub & Frankenberger, 1999), Public presentations and personal use of networks are considered important for determining the speed and shape of the diffusion process in the market (Bohlmann et al., 2010). Also, collaborative design aspects address social skills such as: a) conflict resolution, negotiating roles and responsibilities, and managing client relations (Lauche, 2007), and

b) knowledge sharing and integration in the context of cross-functional teamwork in design (Edmondson & Nembhard, 2009; Kleinsmann et al., 2012), which describe the social interaction processes that occur in design as discursive processes. Thus, the development of social skills is interrelated with the goals and structures of the design process itself, and affect the development and maintenance of a design culture (Gray, 2011).

Interpersonal communication develops in PI through the provision of input into diverse problem-solving to enhance meaningfulness (Im et al., 2013), designer and team performance (McMahon et al., 2004) and design outcomes (Durmuşoğlu, 2013), especially in projects with high levels of uncertainty (Kraut & Streeter, 1995). However, collaborative capabilities depend on various aspects such as the levels of expertise (Kleinsmann et al., 2012)and emotional intelligence (Jordan & Lawrence, 2009).

4.3.5 Education-based Knowledge

Education-based knowledge encompasses a range of competencies, including technical competencies, and basic and specialized competencies acquired through formal design education. Education-based knowledge in relation to DPI is crucial professional knowledge comprising the main abilities taught in design schools, and theoretical-scientific and practical-personal (or "tacit") knowledge.

The literature refers to language competency in design (Bucciarelli, 2002; Dong, 2009), basic knowledge in design (McLaren & Stables, 2008; Wilpert, 2007), and focused knowledge in the working area (Krawczyk & Murphy, 2012; Seitamaa-Hakkarainen & Hakkarainen, 2001). Knowledge derived formal education, such as domain-relevant skills, is considered integral to the development and materialization of creative ideas (Amabile, 1996; Oxman, 2004). However, empirical design research shows that academic engineers tend unconsciously to tackle design problems in a different way to practical engineers with no theoretical education. Academic designers address design problems more theoretically, more systematically and with higher ambitions (Heymann, 2015).

Education-based knowledge develops in PI during the period of formal education and contributes by setting "values and beliefs associated with the activities of designers, how they are done, and the ideas held about their work" (Littlejohn, 2011, p. 38). Existing theories of domain-based expertise (Anderson, 1989; Popovic, 2004) suggest that a critical aspect of skill acquisition is the move from initial to specific reliance (Ball et al., 2004; Wilpert, 2007). These skills may be relevant, also, to the implementation of designs (Baer, 2012) and the development of PI. Cognitive preferences, such analogic reasoning, foster the assumption and social perception that designers are, for example, good at drawing and may consider specific abilities as designers' identity designer, or as an authorship mark (e.g., Basa and Şenyapılı 2005).

4.3.6 Practice-based Knowledge

Practice-based knowledge is the range of competencies related to practice, expertise and know-how, which cannot be taught or conveyed by one person to another, but is acquired through practical work (Collins, 2010). In the context of the designer's PI, it can be considered a rich base of personal 'tacit' knowledge, as knowledge that cannot be replaced by or transformed into theoretical knowledge (Heymann, 2015), and as knowledge that is expressed in design expertise (Lawson & Dorst, 2009).

The literature refers to negotiation capacity, imagination and representation quality and speed, information technology (IT) competencies, and the ability to apply knowledge. Experts create visualizations and shift rapidly between design tasks, particularly during the problem generation stage (Atman et al., 2007; Cross, 2004). Booth et al. (2016) emphasize that, during ideation, freehand sketching helps designers to handle different levels of abstraction (Cross, 1999; Goldschmidt, 1991), think through problems (Buxton, 2007; Pascail, 2006), understand and cope with ill-defined problems (Cross, 1982; Kimbell, 2011), and extend short-term memory for problem-solving (Schütze et al., 2003; Ullman, 2010), and aids communication and team building (Goldschmidt, 2007). Therefore, despite the proliferation of technologies to enable high-end representations, e.g., CAD software, free-hand sketching and analogue reasoning are essential for design education (Ullman et al., 1990)

Practice-based knowledge develops in PI through the accumulation of practical experience and consolidation of designer abilities. Negotiation with different stakeholders, i.e., users, clients, legislators, manufacturers (Ball & Ormerod, 2000), is enabled by design project experience in persuading and convincing stakeholders of the value of the design (Lawson, 2005). However, Ball et al (2001) argue that design expertise is rooted in applying previous knowledge, once a fair proportion of expert's problem-solving ability may be a collage from past solutions that are known to be effective (Oxman & Planning, 1994), of familiar kinds of problem. However, when faced by an unfamiliar design problem, without the benefit of highly schematized knowledge from prior experience, the expert designer relies on analogizing and reasoning capabilities (Visser, 1996).

4.3.7 Managerial Competency

Managerial competency encompasses the competencies related to designer perceived managerial capacity, at the personal or group level, i.e., with colleagues or within a team. It considers DPI as a person-related sense of competence, i.e., sets of behaviours relevant to the job's tasks and function (Woodruffe, 1993). It incudes the ability to conduct person-related and job-related tasks, regardless of the project manager's competence for influencing the eventual project outcome (Stevenson & Starkweather, 2010).

The literature mostly considers managerial competency related to generic tasks, i.e., personal organization and time management, or to job-related tasks, i.e., meeting deadlines and project milestones. According to the National Academy of Engineering (2004), the attributes required of an engineer in 2020 will be increasingly complex due to the impact of new technology. They will require management skills, and communication and leadership skills, to enable development of a strong sense of professionalism and high ethical standards, dynamism, agility, resilience and flexibility as professionals. This will involve lifelong learning. A design manager requires mastery of a broad skills base include expert knowledge of design and DS, knowledge of human dynamics, understanding of people and processes, and knowledge of basic business practices, management, business and negotiating skills (Green et al., 2010; Peters, 2012).

Managerial competency develops in PI as the capacity to deal with issues related to people and relationships (Loufrani-Fedida & Missonier, 2015), risk perception (Jerrard & Barnes, 2006), project management and personal values (Thomas & Mengel, 2008). It is based on use of "soft personal skills" (Balcar, 2014; Stevenson & Starkweather, 2010). Khapova et al. (2007) consider PI as key to career change intentions such as aspirations for a managerial position within the company, based on

familiarity with and knowledge about the field. By developing managerial competency, designers can assume more strategic roles and responsibilities and push the boundaries to their activities (Kang et al., 2015).

4.3.8 Project Management

Project management includes the ability to develop and manage a project including planning project tasks, achieving milestones and evaluating effectiveness and outcomes. This skill in the context of DPI is the ability to manage work tasks efficiently and demonstrate competence and professionalism characterized by dynamic achievement and satisfaction (Skorikov & Vondracek, 2011). However, project management differs according to whether it is considered at the company or team level (Kang et al., 2015). Many firms consider design managers to be specialists, who set an example for their designer employees (Gornick, 2010).

The literature considers project management as including project planning, project development and assessment of project effectiveness. Thus, the ability to plan a project is a basic aspect of design work (Yang et al., 2005b) and is especially important in a consultancy context (Hakatie & Ryynänen, 2007), where client's demands and the designer's decisions must be aligned to achieve an outcome that satisfies both parties. The development of a project plan with timelines and cost estimates sets the basis for the subsequent phases of the design process (Lewis & Bonollo, 2002). Similarly, controlling project performance requires identification, evaluation, processing and monitoring of risks and, also, management of decisions to ensure their effectiveness (Gidel et al., 2005).

Project management develops in designer's PI by accounting for other than only individual perspectives in the design activity (Kimbell, 2012), by using the professional intellect to create value in the economy (Quinn et al., 2000), by bearing strategies to avoid premature commitment to single solution options (Ball & Ormerod, 2000), and by reaching corporate recognition for designer's managerial competency.

4.4 Towards a framework for Designer's Professional Identity

The aspects identified in literature dynamically establish individual DPI development as based on certain *essential elements for a designer*. The elements of DPI include Personal Attributes (PA) and Design Skills (DS) as part of a cohesive framework. The elements of PA (Table 4), represent professional ways of being (Dall'Alba, 2009), contribute to individual behaviour and mental models, and add to our understanding of the profession (Adams et al., 2011; Berzonsky, 2011). The elements of DS (Table 5), as an expression of expertise development (Ericsson, 2017; Lawson & Dorst, 2009), contribute to self-identification based on intrinsic motivation, and emerging from the achievement of expected capabilities (Patall et al., 2014) and on social aspects such as peer recognition and belongingness (see Chapter 2, section 2.1). The elements of PA and DS have been discussed in the literature and tested empirically. In the case of DS, lists of skills have been proposed to support and improve design education (see Yang et al., 2005). For example, most of the DPI elements discussed in Chapter 4, sections 4.2 and 4.3, can be also found within categories of the Conceive, Design, Implement, Operate or CDIO syllabus, where adaptation to the UNESCO framework is proposed in the context of engineering education (Jørgensen et al., 2011). The established education and professional frameworks help us to understand the value structure and social understanding regarding engineering

practice, and highlight specific issues related to misconceptions and historical changes (Jørgensen, 2007). The synergies between PA and DS are highlighted in both engineering and design education (Crawley et al., 2011; Dall'Alba, 2009). However, the literature does not provide a list of PA and DS elements or a cohesive DPI framework could be found in the literature, while very few studies approach PI as a fundamental aspect of professional development in the design field. There are no holistic overviews supporting the development of theory and further research in this area.

Specifically, for this theoretical development to proceed requires a coherent list of the key concepts to allow examination of their structure and interrelationships. Cash (2018) clarifies the steps to theory building. The present work contributes to the first step of ***Definition of variables and limitation of domain.*** We identify the variables and map their interconnections and boundaries in order to broaden the current understanding. The elements described in Chapter 4, sections 4.2 and 4.3, set the basis for theory building about DPI, by defining what is understood as external perception of expressed design competencies (Horváth, 2006), i.e., as the social-perception of what constitutes *essential elements for a designer* when related to PI and professionalism (e.g., as perceived by peers and, in this case, design researchers). Thus, the DPI elements of this framework constitute the first steps towards a holistic understanding of the designer identity. Figure 3 depicts the proposed DPI framework, based on the PA and DS elements described in this chapter, and summarizes the theoretical outcomes of this work.

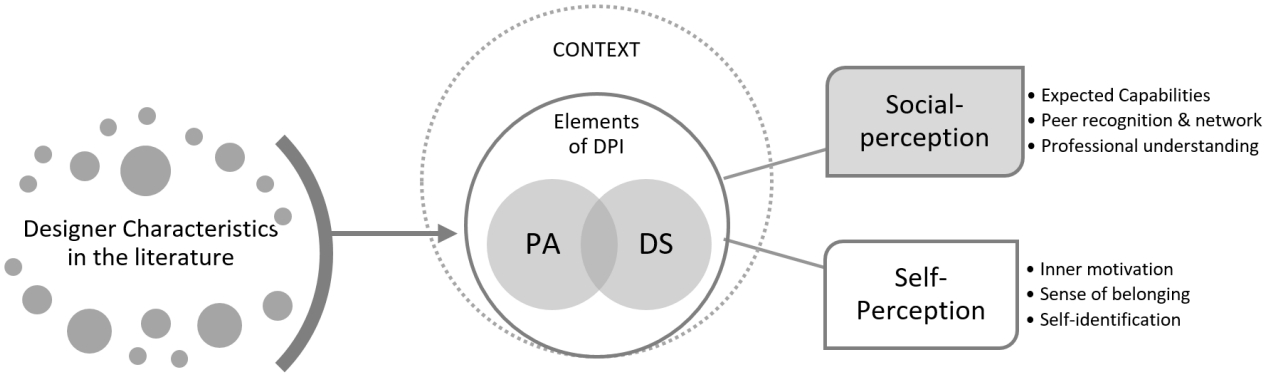

Figure 3. Generic representation of the DPI framework distilled from literature

The DPI elements derived from the literature are organized as two cohesive sets of elements, PA (Table 4) and DS (Table 5), reflecting the interrelations and common sense among professionals in the design field. DPI emerges as an integrated view including acquired knowledge and *"designerly ways of thinking"* (Cross, 1999, 2010). Also, since PI is a phenomenon that relies on both social- and self-perception (see Chapter 2), we assume that PA and DS are driven by perceptions within the context of design. These interwoven relations, depicted in Figure 3, are described in Baumeister & Muraven (1996, p. 441) in their reflection on career as a record of distinctions in a resumè, where professional tasks are accomplished to build identity in the form of advancement and recognition that validate the good qualities of the self. Future work could focus on empirical investigation of the interactions among the elements in this framework, embracing the relational aspects (as described in the literature) and taking the analysis and discussion of DPI elements to the next level. Such an investigation and methods to describe the specific relationships among the variables and their underpinning mechanisms, would add to the theory in the form of ***Relationship building*** (Cash, 2018).

The analysis of the *essential aspects for a designer* presented in Chapter 4, sections 4.2 and 4.3, showed that many of the sentences analysed described explicit interactions between PA and DS (see the example in Appendix 1 (section 4.7.3). This pattern of interrelations between PA and DS, in the sentences extracted from diverse publications, can be matched to most of the DPI elements discussed in Chapter 4, sections 4.2 and 4.3, suggesting an indissociable connection between personal aspects and trained competencies in design. Lawson & Dorst (2009) questioned the tendency to shape the profession only as a set of design skills and suggested adding learning and design thinking as new perspectives, which provides more than describing designers only through their practices. Thus, both PA and DS contribute to the establishment and development of the DPI, and cannot be dissociated from each other since the designer must be understood as both a person and a professional. The alignment of PA and DS suggested by the proposed framework (Figure 3) allows a holistic overview of DPI, in a specific professional context (Baumeister & Muraven, 1996; Cohen-Scali, 2003) and includes the process of learning how to become a designer (Dall'Alba, 2009). Future work could analyse the importance of PA and DS elements in different work or cultural contexts, which would offer new perspectives on social- and self-perception and allow a better understanding of work limitations and behaviours based on contextual differences.

As discussed in Chapter 2, professional self-understanding is built on this socially accepted professional image, which guides and shapes expectations and career projections over the years of education and practice (Skorikov & Vondracek, 2011). Furthermore, in the process of building DPI, the designer becomes immersed in a lifelong learning process which allows acquisition of design expertise (see Chapter 2), building of social networks and evolution of a progressive mind-set and reasoning capacity (Ahlgren & Tett 2010). Chapter 4, sections 4.2 and 4.3 show that the PA and DS elements which comprise DPI, evolve differently. PA elements (see Table 5) carry out the tacit assumption of immutability related to personality traits (Brooks et al., 2010), although some studies suggest it is a function of the social context and is susceptible to change based on behavioural reflection and concept internalization (Yılmaz et al., 2015). In contrast, the DS elements (see Table 6) are marked by a process of constant change and maturation over time based on the accumulation of knowledge through experience and learning processes, e.g., formal education (Dreyfus & Dreyfus, 2005). In a professional context, expertise can be the result of stored experiential knowledge and reflection, as DS matures through practice and the development of PA, e.g., self-confidence, co-evolving with a designer identity (see Chapter 2, section 2.3) and adaptation to context and behaviours (Larsson et al., 2009; Tynjälä, 2008). Thus, PA can be understood as a gradual updating of DPI (see Chapter 4, section 4.2) while DS can be considered more dynamic (see Chapter 4, section 4.3). These aspects of expertise evolve with some skills being more developed than others (see Chapter 2; Lawson & Dorst, 2009) and the synergy between PA and DS in the construction of DPI leads to a complex non-linear development of expertise that is not completely understood. Furthermore, although the elements of DPI are expected to develop over time due to knowledge and expertise acquisition, the social- and self-perceptive aspects are also expected to change to adapt to the context (Baumeister & Muraven, 1996). Adams et al. (2011) reflect on the importance of education to become a professional in design, and the significance of the multiple dimensions to learning in addition to knowledge and skills progression. This underlines the difficulty related to establishing a framework for understanding about the role of the designer, the path to becoming a design professional, and the type of education needed to tackle practical design challenges. Further research is needed to empirically evaluate temporal changes in the development of both PA

and DS elements. More research into the dynamic of these elements over time would provide a better understanding of the developmental aspects of DPI.

Finally, both the PA and DS elements presented in this work (Tables 4 and 5) are expressed in terms of the actions and behaviour of professionals during a project or in a design context (see descriptions in Chapter 4, sections 4.2 and 4.3) and how designers are perceived socially (Adams et al., 2011; Dall'Alba, 2009). Thus, PA and internal motivations act as a psychological filter (Robinson et al., 2012) for the design activity and provide a basis for the decision-making process (Boulanger & Smith, 2001) allowing self- and social-perception of *doing the right thing* (Ashton & Durling, 2000). It seems clear that DPI, more than PA and DS, is regulated by other cognitive processes such as self-perception and awareness, which could contribute to cognitive capability (Helfat & Peteraf, 2015), design activity and PI. According to Hellström (2005), designer roles are assumed or sought because they are seen as emphasizing certain (perceived) personal qualities, affirming the designer's choice. More work is needed to investigate designers' self-perception and the influence of internal motivation and the individual triggers that contribute to and support DPI. Future work could use the proposed framework to evaluate the self-perception of designers with different levels of expertise, regarding the designer's role and career motivations.

4.5 Conclusions

DPI is a social- and self-perceptive aspect, which the designer identifies, based on the contextual situation of design as a profession. Career development for designers involves a lifelong learning process that allows self-identification and recognition as a design professional. This process of professional recognition frequently is associated to the capacity to perform and behave in a reliable and satisfactory way and has been studied, mainly, through the lens of expertise development. However, no cohesive framework has been proposed to explain and study the overall phenomenon.

The work in this chapter tries to provide a better understanding of designers' characteristics by identifying the elements comprising DPI from current work on design knowledge. We investigated what the literature describes as *essential elements for a designer*. We also discussed how PA and DS are related and how they develop, providing a contribution to discussion of and theory on DPI. The *essential elements for a designer* identified, fall into two distinct sets of elements that comprise DPI: PA and DS. We discussed both components separately to clarify their meaning, possible relations and contribution to DPI development, within a cohesive framework. This work brings together some aspects that are fragmented in the from literature, to categorise those PA and DS elements considered important for design professionals and which determinate the variables that should be analysed to provide a better understanding of DPI. The proposed framework adds to the theory and should incentivize further study of DPI (Cash, 2018). It combines theoretical and empirical reflections and observations from the current body of knowledge in the design field. The study in this chapter provides some preliminary insights into the inter-relational aspects of the DPI elements and the framework variables, which could be used for further studies of DPI development over time. Thus, this study contributes to the conversations within design education, design research and design practice by pointing to the benefits of a macro perspective on the professional designer.

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4.7 Appendix 1

4.7.1 Number of publications per journal collected in the 1st phase

REF	Journal Name	#
1	CoDesign	205
2	Design and Culture	164
3	Design Issues	75
4	Design Management Journal	25
5	Design Philosophy Papers	181
6	Design Science	13
7	Design Studies	163
8	Journal of Engineering Design	615
9	Journal of Product Innovation Management	296
10	She Ji	19
	Total	**1756**

4.7.2 Complete table of term frequencies from terms-searching in the database

Journal reference number	1	2	3	4	5	6	7	8	9	10
Designer	191	143	70	23	139	13	160	522	51	15
Personal Attributes	0	1	1	0	0	0	2	1	2	0
Personal Characteristics	2	0	1	1	1	0	6	5	9	0
Personal Skills	0	0	0	2	0	0	2	2	3	0
Personal Qualities	0	1	1	0	0	0	2	1	0	0
Design Skills	11	2	3	6	8	0	22	8	5	7
Ethics	26	31	12	0	74	1	18	11	19	5
Emotions	38	22	10	5	12	0	10	33	25	1
Social Abilities	0	0	0	0	0	0	0	0	0	0
Social	185	141	65	20	145	11	119	173	176	19
Social Skills	7	0	1	0	1	0	0	1	3	0
Sociability	4	3	0	0	1	0	0	0	1	0
Leadership	27	16	9	14	18	0	23	53	109	7
Empathy	35	14	7	0	9	0	10	18	5	3
Responsibility	58	50	19	8	74	1	41	83	82	15
Motivation	63	11	14	7	32	4	48	125	86	2
Openness	26	10	4	1	18	1	14	8	44	1
Open Mind	4	1	1	0	0	0	2	0	2	1
Open Minded	5	0	1	1	1	0	4	5	6	0
Creativity	119	45	36	17	38	7	103	152	119	12
Inventiveness	4	2	1	0	3	0	1	6	0	0
Imagination	54	54	19	3	48	3	24	28	21	6
Innovation	125	69	45	23	65	11	87	259	296	19
Confidence	39	12	9	4	0	0	34	96	76	2
Self-Confidence	2	2	2	1	0	0	6	5	4	1
Cognitive Abilities	5	0	0	0	1	0	6	3	2	0
Understanding	192	120	56	19	131	13	148	402	199	13

Thinking	148	90	43	19	142	11	128	180	87	17
Abstracting	5	2	0	0	4	2	9	15	5	2
Evaluating	75	12	10	5	13	6	69	275	109	4
Cognitive Strategies	1	0	2	0	0	2	14	4	2	0
Learning	141	52	29	16	86	11	117	218	196	14
Problem Framing	6	0	1	0	2	0	11	2	0	2
Development	190	111	58	25	134	13	154	560	222	19
Problem Solving	0	0	1	6	27	6	109	160	95	7
Personal Communication	3	1	1	0	1	0	4	11	5	0
Interpersonal Communication	2	1	0	0	0	0	2	2	2	0
Communication Skills	9	0	1	1	1	0	3	5	5	0
Personal Interaction	2	0	0	0	1	0	0	1	3	1
Communicate Clearly	0	0	0	0	0	0	0	0	1	0
Communicate Directly	0	0	0	0	0	0	1	2	1	0
Attends to Details	0	0	0	0	0	0	0	0	0	0
Empathize	0	3	3	0	1	0	0	1	2	0
Rapport Establishment	0	0	0	0	0	0	0	0	0	0
Collaboration	154	51	19	6	18	5	67	125	99	10
Proper Communication	0	0	0	0	0	0	0	0	1	0
Adequate Presentation	0	0	0	0	0	0	0	0	0	0
Education	115	81	42	16	104	8	113	155	79	18
Educational Knowledge	0	0	0	0	0	0	0	1	0	0
Learned Knowledge	1	0	0	0	0	0	1	0	0	0
Knowledge	188	101	50	24	135	13	155	469	212	16
Language Competencies	0	0	0	0	0	0	1	0	0	0
Focused Domain	0	0	0	0	0	0	0	0	0	0
Practice	175	128	59	22	142	9	138	374	188	16
Practical Knowledge	3	1	2	1	2	0	1	4	1	1
Negotiation	57	12	9	1	19	1	30	33	19	1
Imagination	54	54	19	3	48	3	24	28	21	6
Creativity	119	45	36	17	38	7	103	152	119	12
Representation	91	50	31	7	43	9	100	358	53	4
IT Competencies	0	0	0	0	0	0	0	1	0	0
Software	105	40	25	13	38	8	84	376	135	10
Appliance	11	9	2	1	3	0	3	14	7	0
Applied Knowledge	2	1	1	0	4	0	0	2	0	0
Managerial Competencies	0	0	0	0	0	0	0	0	1	0
Manage* Competencies	1	0	0	0	0	0	1	1	4	0
Generic tasks*	0	0	0	0	0	0	1	3	0	0
Job*-related tasks	0	0	0	0	0	0	0	0	1	0
Project Management	16	2	5	3	4	1	19	84	76	0
Planning	102	53	24	11	65	5	97	309	143	10
Development	190	111	58	25	134	13	154	560	222	19
Effectiveness	67	9	12	8	12	4	51	217	130	5

* ALL search results were obtained using "QUOTE MARKS"

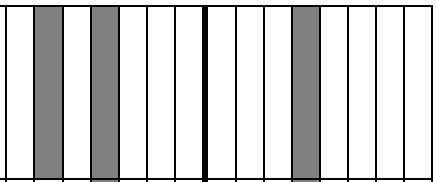
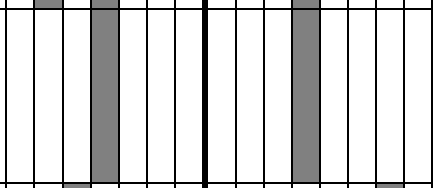
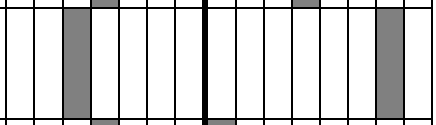
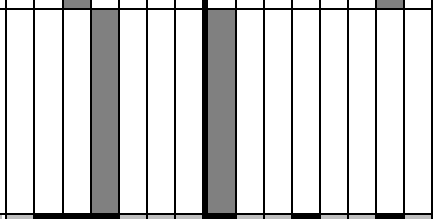
4.7.3 Example of aspects identification from literature into DPI elements

	Ethics	Emotions	Social Abilities	Leadership / Empathy	Responsibility/ Motivation	Openness / Creativity	Confidence / Self-confidence	Cognitive Abilities	Cognitive Strategies	Personal Communication	Interpersonal Communication	Education-based Knowledge	Practice-based Knowledge	Manager Competencies	Project Management
It is, therefore, important to determine the students' values as designers/individuals to demonstrate how sustainability issues and politics are intertwined with all of our ethics and specifically with the students' professional ambitions and goals.(Benson & Napier, 2012)	■														
Participating in a scaffolding of experiences provides an opportunity not only to build an understanding of how personal values and perspectives affect why, how, and what we design, but also to craft generative and evaluative questions to initiate research, dialog, reflection, collaborative activities, ideation, and decision-making throughout the design process.(Benson & Napier, 2012)	■							■			■				
It was also assumed that the Millennial designer yearned to learn how to be a more responsible professional and viewed sustainable practice as vital for our society, our planet, and their future careers.(Benson & Napier, 2012)					■										
Having a great portfolio and challenging job would allow their work to be seen/heard and consequently make some sort of difference – whether it be pleasing the client or bringing awareness to an important issue. These ideals were the core goals that seem to motivate the majority of the current generation of communication designers to excel in/out of class.(Benson & Napier, 2012)	■ Values				■								■		
(Benson & Napier, 2012)	■				■			■			■		■		
The designer whose imagination is trained on aesthetic finish and blue-sky creation tends to (learn to) overlook potentially important details within the kinds of complexes we've been pointing to.(Gill & Lopes, 2011)								■				■			

	Designers might support the regeneration of declining practices and services (cobblers, parts recyclers, repairers, and the like) to strengthen the capacity for sustainment. They might also be encouraged to develop a memory for lost or dying practices. (Gill & Lopes, 2011)
	(Gill & Lopes, 2011)
	Janlert and Stolterman (1997) argued that designers should pay attention to the consistency and coherence of all facets of the product design, when designing a product with a certain personality. (Mugge, Govers, & Schoormans, 2009)
	designers need to design all relevant product aspects in such a manner that the whole product is perceived as having the desired personality. (Mugge et al., 2009)
	Designers should keep in mind that all personality characteristics can play a role in determining a product's personality. (Mugge et al., 2009)
	(Mugge et al., 2009)
	Architectural design consists of a complex set of activities and the associated skills of visualization, drawing, formal logic and emotional reflection, among others (D'souza, 2006, 2009). (D'Souza, Yoon, & Islam, 2011)
	architectural design problems vary in content, scale and complexity, and a designer needs to apply a repertoire of mental representations to solve a design problem. Add to that the process of thinking at various scales (macro to micro) and at varied degrees of abstractions (abstract to concrete, symbolic to literal, etc.).(D'Souza et al., 2011)
	To deal with this wide array of activities, designers need to use multiple skill sets and representations. (D'Souza et al., 2011)
	The designer should convey the ability to understand spatial layers in terms of shallow and deeps paces. The designer should have sensitivity to tactile properties such as spatial volume, texture, visual weight and material density. (D'Souza et al., 2011)
	The designer should have the ability to think and illustrate in sections and plans simultaneously. Ability for cognitive modeling and to imagine space for a sustained period of time. (D'Souza et al., 2011)
	The design intentions and drawings should convey the ability of the designer to think…(D'Souza et al., 2011)

	(D'Souza et al., 2011)	
	The designer, in all circumstances, is always confronted with design choices (related to budget, materials, aesthetics, etc.). Therefore, as the first phase, in order to make an ethical design decision that is 'authentic', the designer has to recognize that he/she has a choice. As soon as this fact is acknowledged, the designer should determine a range of possible different design choices, regardless of their impracticality. Such impracticality does not mean that the design choice does not exist, but it could implicitly show that some design choices conflict with a pre-existing goal. (d'Anjou, 2011)	
	Practicing design in an authentic manner requires that the designer acknowledge that what defines him/her is freedom. It also requires that in order to re- ally exercise his/her design freedom, the designer has to accept that he/she is responsible for his/her design choices. From a practical point of view, this signifies that decision-making structures, committees, codes or policies cannot preclude the designer's own personal responsibility to make a design choice. In the same manner, the designer cannot rely on other actors involved in any given design situation to make a choice for him/her, or he/she cannot avoid making the choice in the hope that the ethically problematic design situation will in some way resolve itself. (d'Anjou, 2011)	
	Typically, the designer's prior design choices reflect his/her personal existential goals and projects. The design choices of the designer are not separate occurrences; they are part of his/her goals at a relative level as well as at a fundamental one. (d'Anjou, 2011)	
	the reflection of the designer is embodied within the world, which is effectively created by him/herself through his/her own interpretations and actions. (d'Anjou, 2011)	
	the Sartrean-based model proposed here is successful in its consideration of the designer's own personal goals and projects, in fostering individual design responsibility, and in avoiding to simply follow the external 'ethical' impositions. (d'Anjou, 2011)	

	This becomes particularly relevant if designers take into consideration the multiplication of codes of ethics, and concerns related to how to 'enforce' ethical practice. In this sense, an approach to ethical decision-making in design grounded in Sartre's existentialism and ethics sheds light on ethical dilemmas in terms of individual freedom and responsibility, and in its acceptance and analysis of subjective experiences and personal situations. In that sense, such an approach provides a complementary layer of ethical consciousness in design practice so as to enrich design consciousness. (d'Anjou, 2011)														
	(d'Anjou, 2011)														
	If this more essential significance is to somehow inform and affect the nature of our material culture, designers must bring a rather different sensibility to their work. Such significance cannot be achieved through rationalizations or rigid, literalistic interpretations but through the ambiguities, uncertainties and potency inherent to allusion, symbolism and aesthetic experience. (Walker, 2012)														
	the designer has to distinguish true creativity, the imaginative, and the meaningful from the surfeit of mundane veneers that have come to characterize the discipline in recent decades… the designer has to draw on other sources and perhaps especially those too-easily-forgotten aspects of human society, culture and tradition that have long been associated with the struggle towards inner development, meaning and becoming fully human. (Walker, 2012)														
	the designer's role is one that inescapably includes ethical, and even spiritual, considerations. (Walker, 2012)														
	(Walker, 2012)														
	Designers are looking at how, within increasingly complex times, they can create relevant emotional connections with ideas, products, services and brands. It gives the designer more responsibility in strategically developing broader visions for clients beyond traditional product design. (Crossley, 2003)														
	Intuition plays a large part in how ideas are formed, but designers cannot rely solely on their own emotions in the designs they create. (Crossley, 2003)														

	as designers, we need to broaden our focus and build empathy and emotional understanding between members of the design team, clients, ourselves, as well as the people for whom we design. (Crossley, 2003)	
	Collaboration can be problematic; communication across disciplines and designers joining research too late in the process has been noted as a challenge to effective integration of users' experiences. (Crossley, 2003)	
	the designer should become the mediator between different parties to get the best from them. (Crossley, 2003)	
	The key talent of designers is having deep empathy for the people they design for. They understand how people experience products, services and environments now, and have understanding of the contexts in which new design visions will live. (Crossley, 2003)	
	(Crossley, 2003)	

5. Study 2 - Designers' Professional Identity: Education, Awareness, Expectation, Motivation

Designer's Professional Identity (DPI) is a social- and self-perceptive construct that enables designers to identify as professionals. To further understand DPI, this study considers it as the result of an alignment between social and individual aspects supported by Personal Attributes (PA) and Design Skills (DS). This provides the basis for a discussion of DPI development that captures the influence of education, awareness, expectations and motivations regarding the designer's professional role. The aim of this chapter is to investigate DPI development over time based on Education, Awareness, Expectation and Motivation – from the beginning of the engineering design education to professional positioning as a design engineer. A survey was administered to 386 individuals at different states of their professional development - Beginners, Intermediates and Professionals (up to ten years of experience), in two institutions - DTU in Denmark and TU Delft in The Netherlands. The questionnaire included both quantitative and qualitative questions. The qualitative results suggest that DPI, as a psychological process, is linked strongly to an understanding of the professional role and relies on personal motivation and career expectations. The responses to the quantitative questions are inconclusive, leading to the need for further investigation and refinement of the survey instrument. Professional development in design has been studied, mainly, through a design expertise lens and on the basis of specific observed skills. This study contributes to existing knowledge on DPI by applying these lenses to Professional Identity (PI) over the design engineering career.

Keywords: Professional Identity, Personal attributes, Design skills, Student Perception; Professional Skills;

Designer's Professional Identity (DPI) is a social- and self-perceptive construct that allows the designer to identify as a professional. To avoid drop out during education or in the early phases of their career, it is important to create an alignment between the designer's perception of the profession, his or her position in it, and the expectations of others (Murphy et al., 2015). Knowledge of DPI enables the development of tools and guidelines to enhance student's professional consciousness and support the designer's understanding of his or her role, which increases confidence and professional development (Skorikov & Vondracek, 2011). The sense of belonging to a group and, so to a profession, is integral to the self and reflects directly on development and performance in the work context (Adams et al., 2011). A complementary perspective on design education allows a better understanding of what contributes to the development and maintenance of DPI. This addition to traditional skills-focused training could foster and strengthen designers' sense of identity, which could lead, also, to an easier transition from student to self- and socially-recognized status of designer and reduce dropout (Smith & Whitfield, 2005).

Chapter 4 reviewed the relevant literature and provided , a synthesis of the elements attributed to a designer's DPI, showing that DPI development depends on the alignment between the individual's self-perception and external factors such as established professional norms, developmental expectations, the perception and value of "design as a profession", and the education process (Jensen & Jetten, 2016).

It employed a holistic approach to the elements identified from the literature, constituting the two categories of: Personal Attributes (PA) and Design Skills (DS) (see Chapter 4). PA describe identity, expressed externally by *being a designer,* and the relation between mind and body or attitude (Dall'Alba, 2009). DS describe cognitive, technical and behavioural characteristics related to the practice of design activity, which comprise the skills necessary for design work (Galle, 2009) that can be learned through training and practice (Golja & Schaverien, 2007; Lawson & Dorst, 2005).

Designers' self-perception and professional awareness change continuously as the result of external stimuli such as knowledge acquisition through education, new operational contexts and reflection on their work and their profession (Godsey, 2011; van Knippenberg et al., 2004). The development of DPI is an ongoing dynamic process. However, there is a lack of understanding the *progression* of DPI. The research in this chapter investigates DPI development over time from the beginning of design education to professional positioning as a designer. The aim is to provide initial insights into DPI as a developmental aspect and the influences of professional self-perception, i.e., awareness, professional expectations and motivations for subjects joining or leaving the design profession. As explained in Chapter 2, education fosters the insertion of the student in the community of practice (Wenger, 1998b), after which, perceptions and DPI within the analysed groups are expected to follow a linear progression based on the development of design expertise (Lawson & Dorst, 2009).

A specifically designed survey was used as the instrument to collect qualitative and quantitative data on designers' perceptions of their daily activities (related to PA and DS) and their views about the design profession including motivational triggers and professional roles. The theoretical framework is grounded on four topics related to both social and individual aspects: i) Education – the expected development of DPI over time; ii) Awareness – the expected development of PA & DS categories regarding awareness of daily activities; iii) Expectation – an overview of expectations based on the importance of DS for a good designer; and iv) Motivation– a initial overview of the professional role to understand the individual triggers related to motivation

The survey was administered to 396 subjects at three different levels of development (Beginners, Intermediates and Professionals), from two major design schools in DTU, Denmark and TU Delft, The Netherlands. The cross-sectional evaluation covered these distinct groups in important phases of their professional formation: students at the beginning of their design education, i.e., Beginners (Bachelor level); design Intermediates (at the end of Masters level), and Professional designers (with up to 10 years of practical experience).

This chapter is organised as follows. It starts with a literature review (section 5.1) of work on DPI development and aspects related to the influence of PI, self-perception, and expectations on the design career. Based on the literature review, we propose a framework for DPI development through the alignment of social and individual aspects and highlight the research questions addressed in this study. Section 5.2 describes the research methods used to develop and analyse the survey. Section 5.3 presents the results of the qualitative and quantitative responses. Section 5.4 discusses the relation between our results and the findings in the literature, highlights some implications and limitations of this work and suggests directions for further work. Section 5.5 concludes the chapter.

5.1 Literature Review and Theoretical Framework

5.1.1 The development of DPI

The literature describes PI as the dynamic organization of professional self-perception, and considers it a 'state of mind' or an awareness level at which the individual one can identify him/herself as belonging to a professional group (Crossley & Vivekananda-Schmidt, 2009; Skorikov & Vondracek, 2011). Similar to other professions, in design PI is influenced by significant relationships and broader social factors such as societal norms and expectations, and economic and technological change (Skorikov & Vondracek, 2011). For instance, engineering identity is defined by Dehing et al. (2013) as combining three characteristics: (a) acting like an engineer, (b) being recognized as an engineer, and (c) believing oneself to be an engineer. Thus, the designer's PI can be seen as both an individual and a social attribution supporting one's identify as a designer (Baumeister & Muraven, 1996; Norlyk, 2016).

The individual elements relate to the construction of a self-understanding as a professional through professional skills, in which self-identification seems to develop in parallel with or as a function of expertise, and is reflected externally as professional behaviour or "acting like a designer" (Tracey & Hutchinson, 2016). Furthermore, according to Dent & Whitehead (2001, p. 11), "*identity is neither stable, nor a final achievement*", rather, it is a never-ending process which can exist only if its meaning is anchored in relation to the 'other'.

The social aspect of PI relates to both peer-recognition and social support (Cohen-Scali, 2003; Skorikov & Vondracek, 2011). In this sense, public understanding regarding the professional role and the expectations related to building a socially acceptable professional stereotype, have a major influence one the individual's confidence and sense of belonging to the professional group (Skorikov & Vondracek, 2011). Eliot & Turns (2011) would argue that the PI is based on the knowledge, emotions, abilities and experiences surrounding one's role as a designer. Also, PI is related directly to professional development and experience (Skorikov & Vondracek, 2011) and is strengthen by (1) years of experience, (2) development of a professional network (Dobrow & Higgins, 2005a) and (3) contextual factors that influence external perceptions of the profession (Smith & Whitfield, 2005; Smith, 2015).

Based on Chapter 4, DPI construction requires the development of both Design Skills (DS) and Personal Attributes (PA) through improvements to cognitive and practice-based skills, and alignment to personal-behavioural attributes. Thus PA constitutes the personal level DPI elements, while DS express skill-related elements in the practice of designing. The literature on design expertise provides a good knowledge base for studying the development of DS and PA over time; it describes the characteristics, skills and knowledge that distinguishes expert designers from novice designers (see e.g., Lawson & Dorst, 2009). It shows that design expertise usually is acquired via a period of deliberate practice and training, supported by sustained involvement before performance attracts international peer-level recognition (Ericsson, 2017) – approx. 8 to 10 years from first involvement (Ahmed, 2007). This process usually involves pattern recognition among work-related activities and problems, in which intuition is explained as the product of associative memory (Dreyfus, 2015). Table 7 presents the overlaps between formal education in design, the years of involvement in the profession and the levels of expertise described in the literature. Thus, design education at bachelors level marks the beginning of formal training; the masters degree and the first five or six years of active involvement

with design practice marks the end of formal design education. After completion of formal education, the design student becomes a professional who is expected to have mastered the fundamental knowledge and can develop confidence through practice.

Table 7. Education, years of experience, and expertise in Design

Level of development	***Beginners***			***Intermediates***			***Professionals***			
Education in Design	Bachelor degree			Master degree			Professional activity			
Years of experience	1	2	3	4	5	6	7	8	9	10
Design Expertise	Novice	Adv. Beginner		Competent	Proficient		Expert/Master			

Given the length of time period dedicated to professional activity during education and professional practice, the three levels of development provide a general conceptualization of the stages of PI development. After each successive level, the designer is supposed to be more deeply immersed in the professional activity and mind-set, and within the community of practice, leading to the assumption of a progressive development of identity. Research question 1 (RQ1) is framed as: ***Does self-identification and awareness as a designer (DPI) increase over time?***

The development of both DS and PA progress over time, but this process of progression is not described in detail in the literature. The elements of both are assumed follow a linear progression with specific formative elements developing at different rates. Thus, PA is described as related to temporal consistency and as changing incrementally over time; DS is associated to rapid development following formal learning in education or practice (see Chapter 4). For example, the DS of cognitive abilities is described as the skills that relate to designers' reasoning and mind-set as a distinct way of thinking (Cross, 2001b; Evans, 2012). Beginners undertake tasks to gain a better understanding of the problem (Ahmed et al., 2003); intermediates use trial-and-error in a process of coevolution of problem and solution (Saeema Ahmed et al., 2003; Kolodner & Wills, 1996); professionals tend to approach the design task via solution conjectures rather than problem analysis (Lloyd & Scott, 1994). Similarly, the DS of interpersonal communication shows a progression in which beginners are seen as reluctant to ask for advice from experts (Ahmed et al., 2003), but able to collaborate and behave competently by not considering the complexity of the design tasks and by sharing limited amounts of information in the team (Kleinsmann et al., 2012). Intermediates have the ability to design collaboratively not hampered by awareness of the situational factors regarding the complexity of the task. Last, professionals show high-level skills in design and design collaboration and are able to focus their knowledge to find approximate solutions (Kleinsmann et al., 2012); they do not hesitate to ask for additional information or knowledge when necessary (Ahmed et al., 2003). Thus, the levels of development and experience, in terms of communication and collaboration, range from the capacity to balance awareness of the complexity of the task to knowledge search through social interaction.

PA development is expected to occur over a longer time-frame compared to DS, however, it is possible to identify the changes between different levels of development. For example, the PA of confidence is described as lacking in beginners due to missing knowledge (McDonnell, 2016; Reid & Reed, 2016; Zhang, 2015). Intermediates are seen as having sufficient confidence in decision-making to differentiate them from beginners (Ahmed et al., 2003; Tan & Melles, 2010). Professionals are confident due to their experience and decreased uncertainties (Dreyfus,2004b; Zhang, 2015).

Similarly, the PA of emotion shows a progression in which beginners are observed not to be emotionally involved in choosing an action even though they are involved in its outcome (as motivation) (Dreyfus, 2004a). Intermediates express strong emotional attachment (feeling of responsibility and fear of failure) to their outcomes, searching for opportunities and building up expectations (Dorst & Reymen, 2004; Dreyfus, 2004a; Lawson & Dorst, 2005). For Professionals emotion is always present in decision-making; previous emotional experience leads to intuitive proficiency (Dreyfus, 2004a; Edwards, 2012). Thus, the levels of development and experience range from dependence on rules and instructions to deal with the problem to opportunity seeking and creative freedom for solution development, to capability to reimagine scenarios.

Within the time span of professional education both PA and DS will develop. Therefore, the education period is assumed to be critical for the development of DPI. However, the exact impact of design education for each DPI element and professional self-perception is unknown. To try to fill this gap we address research question 2 (RQ2) as: ***What is the role of education in DPI development?***

5.1.2 Professional Identity, self-perception, and expectations

In sociology, PI is defined as a construct influenced by context and how the individual aims to achieve a level of collective recognition (Baumeister & Muraven, 1996; Skorikov & Vondracek, 2011). This search for internal and external reward stresses the importance of intentions and expectations, which are mediated by social relations (Cohen-Scali, 2003; Vohs, Baumeister, & Schmeichel, 2012). In the design case, this means that not only the nature and nurturing of competencies (Cross, 1990) but also intentional commitment to professional development support the development of identity (Cross, 2004), anchored in projections and expectations for the future self, as described by Dubar (1991, p. 121) :

> Basic PI not only constitutes an identity at work but also and more importantly, a projection of oneself in the future, the anticipation of a career path and the implementation of a work-based logic, or even better a training orientated logic.

Studies of design expertise that describe the characteristics of experts, set a level of expected capabilities and recognition over a period of approximately 10 years (see Chapter 2), and discuss the developmental process towards achieving full competency. Thus, the process through which designers' build their self-understanding as professionals is recognized and construction of a PI can be understood as the alignment between two factors: (1) self-perceived characteristics and (2) others' expectations , which constitute their understanding of professional practice (Skorikov & Vondracek, 2011).

PI is linked, also, to personal understanding, in which identity development is a series of recurrent loops (i.e., a sequence of short-term recurring transactions between the individual and her or his context), intended to minimize the discrepancy between one's self-perceptions and the feedback received from others (Luyckx et al., 2011). In short, knowledge gain and work practice acquired over time are reflected in aspects related to building confidence for self- and social-recognition, which are triggered by the requirements expected of professional designers. This interaction between context, skills development and the self in consolidating an identity, is described by Bucciarelli (1994, p. 25):

> *As we move in and out of our different worlds – home, work, play, on the road – technique constrains and guides our associations in some settings to such a degree that it patterns our*

> *beliefs as well as our actions, shaping our values on a grander scale and limiting our aspirations and expectations. At the same time, though, technique is continually shaped and reshaped as we put it to use.*

Thus, a balance between assimilation of reality and accommodation of these interactions within professional expectations related to an expert designer, is necessary for the development of a mature, flexible and coherent identity (Luyckx et al., 2011b). For the designer, it means that, over time, and with experience, professional expectations are lowered to be more mature and realistic and avoiding, for example, the image of "design hero" (Gulari, 2015). At the same time, the years of study and practice, the construction of professional networks (Dobrow & Higgins, 2005a), and peer and social recognition can raise self-awareness about characteristics and developed capabilities. So far, it is not known how expectations regarding DS are perceived at each level of development. The expectation regarding the DS of ideal designers is addressed by research question 3 (RQ3): ***What are the expectations regarding Design Skills that comprise the professional designer?***

Following the expectations thread requires an understanding of their role in developing PI (Ibarra, 1999). The dynamic process of adaptation is built on commitment and adaptation (change according to the situation or identity accommodation) to a congruence with personal identity goals (Khapova et al., 2007; Luyckx et al., 2011). In adapting to changes, personality and identity become inner, hidden entities that are known indirectly through their expression in the individual's actions and roles (Baumeister & Muraven, 1996). Perceptions about what constitutes conceptualization of the role of a designer at each level of development, and the motivational aspects that lead students to enrol in design engineering education, are poorly understood. The situational understanding regarding the professional role and the characteristics that trigger professional choices, such as pursuing or leaving a design career, are addressed by research question 4 (RQ4): ***What is understood as the role of a designer and the motivation for choosing this profession?***

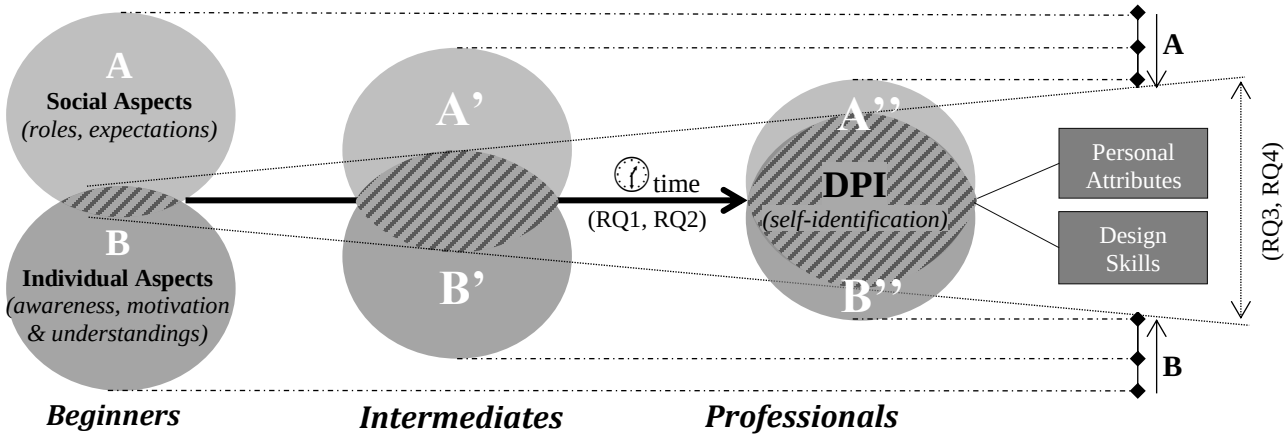
5.1.3 Developing a Theoretical Framework

This chapter investigates DPI development over time to shed light on DPI and provide a new theoretical framework that combines elements of the literature on design expertise (see chapter 2), psychology (see chapter 2), and DPI (see chapter 4).

According to Berzonsky (2011), it is not possible arbitrarily to choose and create a viable identity. The author explains that the process of identity development involves perception and understanding of reality (i.e., social, cultural, and physical contexts), in which personal constructs and current structure of identity influence selection, encoding and interpretation of this information. In this sense, social and individual aspects change and progress over time towards an alignment with each other, based on experience and knowledge. Therefore, the alignment between social and individual aspects is assumed to be an underlying aspect of DPI development. This alignment is driven by perceptions and decisions regarding understanding of the professional role, expectations about skills development and motivational or demotivational triggers.

Throughout education and practice designers gain knowledge and become inserted in their communities of practice and develop DPI elements (Tracey & Hutchinson, 2016; Wenger, 1998). Thus, there is a constant negotiation among their awareness of daily activities, career expectations and initial professional motivation triggers (Baumeister & Muraven, 1996). The theoretical framework

proposed in this study is composed of four topics that permeate both social and individual aspects: i) Education, ii) Awareness, iii) Expectation, and iv) Motivation. Figure 4 depicts a DPI framework for the expected development of DPI based on alignment between the social and individual aspects related to the above four topics. In this model, the two main categories of DPI elements (PA and DS) permeate the process, allowing measurement of the social and individual aspects.



RQ1) Does self-identification and awareness as a designer (DPI) increase over time?
RQ2) What is the role of education in DPI development?
RQ3) What are the expectations regarding Design Skills that comprise the professional designer?
RQ4) What is understood as the role of a designer and the motivation for choosing this profession?

Figure 4. Framework of DPI development through the alignment between social and individual aspects, and assessed RQs.

5.2 Methodology

This study is based on the responses to a questionnaire, which included both quantitative and qualitative questions. The quantitative part refers, mainly, to psychometric items that replicate the method for studying DPI described in the literature (see Cowin et al., 2013; Salehi & Dibazar, 2016; Worthington et al., 2013). Psychometric type questions capture hidden layers of consciousness and avoid biased responses (Furr & Bacharach, 2013). However, due to lack of a validated instrument to tackle the specific aspects of the design field, we developed a pilot instrument based on the DPI elements discussed in Chapter 4.

The qualitative part of the survey aimed at obtaining a deeper understanding of the perceptions and motivations related to professional association. The use of open-ended questions allowed respondent to explain their motivations and articulate their thoughts freely. The questions were designed to help to deeper understand the quantitative data, provide checks for and inform our findings. The questions are not related directly to the psychometric items and constitute reflection on the professional role and career.

5.2.1 Sample & Data Demographics

The sample included 396 subjects with a design background, enrolled as students or assigned as alumni in the design programmes of two large technical universities in Europe: DTU - Technical University of Denmark (N=222) and TU Delft - Technical University of Delft, in the Netherlands (N=174). The assessed respondents at DTU were enrolled or alumni in Design & Innovation. The assessed respondents at TU Delft were enrolled in Industrial Engineering. The participants were split across three levels of development according to their education status or working experience: a) Beginners - Bachelors students (N=181); b) Intermediates - Masters students (N=141); and c) Professionals – graduated designers (N=47). The respondents in the professional group that identified as no longer working in the design field functioned as a control group which we called drop-outs (N=17). Table 8 presents an overview of the demographic characteristics of the data from the survey respondents.

Table 8. Demographic overview of survey respondents

	Beginners *(edu-level=1)*	***Intermediates*** *(edu-level=2)*	***Professionals*** *(edu-level=3)*	***Drop-outs*** *(edu-level=4)*
University	DTU: 42% TU DELFT: 58%	DTU: 45% TU DELFT: 55%	DTU: 100% TU DELFT: 0%	DTU: 100% TU DELFT: 0%
Nationality	Danish: 41% Dutch: 54% Internationals:5%	Danish: 46% Dutch: 28% Internationals:26%	Danish: 80% Internationals:20%	Danish: 76% Internationals:24%
Gender	Male: 44% Female: 55% Other: 1%	Male: 52% Female: 48% Other: 0%	Male: 47% Female: 53% Other: 0%	Male: 47% Female: 53% Other: 0%
Average Age	21,5	27,1	30,7	31,7
Average Working Experience	0,55	1,9	3,7	-

The sample was found to be gender balanced and did not present significant differences between the two sampling groups at the intermediate level of both education programmes in terms of response means (see Appendix 2, section 5.7.4). The samples from both universities were treated as one throughout this study. The logic for this relies on the analysis of responses for the psychometric items. At the Beginners level the comparisons between the responses from the two universities showed significant differences for most of the items, due to students with very different backgrounds and very little knowledge on the subject. However, at the Intermediates level, the differences were non-significant for the majority of items, which suggests a cohesive base provided by the education programme. We assume that both education programmes were similar and able to produce a cohesive group of respondents.

5.2.2 Data Collection and Analysis

The participants were contacted during 2016 and 2017. The data were gathered via a self-administered online questionnaire, using the Qualtrics platform, which took around 10 minutes to complete. The survey was organized in five parts: a) questions asking about the demographic and context, b) psychometric assessment of DPI elements' self-perception (awareness of actual situation), c) ranking of DS elements based on expectation (perception of ideal designer), d) qualitative open-questions, and e) a direct self-report measure of self-identification as a design engineer. More details on the survey structure, questions and coding schemes is provided in Appendix 2 (section 5.7.2). Based on the different parts of the survey, we applied different analytical methods. Table 9 presents the survey structure in relation to the theoretical framework and the research questions.

Table 9. Relation of the methods for data collection and analysis

Theoretical Framework	***Survey Structure***	***Methods of Analysis***	***RQs***
i) Education	a) Demographics & Context	Description	RQ1 (section 5.2)
ii) Awareness & Self-Perception	b) Psychometric assessment DPI elements: PA and DS	Descriptive Statistics ANOVA Tukey HSD Reliability Test Exploratory Factor Analysis	RQ2 (section 5.3.1)
	c) Direct assessment of self-identification	Descriptive Statistics Linear Regression	RQ1 (section 5.3.2)
iii) Expectations	d) Importance ranking of DS elements for ideal designer	Descriptive Statistics Comparison to literature	RQ3 (section 5.3.2)
iv) Motivation & understanding	e) Qualitative open-questions	Axial Coding Qualitative Thematic Analysis	RQ4 (section 5.3.2)

The dataset was split according to the qualitative or quantitative nature of the questions: a) Quantitative dataset, mainly dealing with psychometric assessment (RQ2), and b) Qualitative dataset, mainly dealing with open-ended questions (RQ4) of the survey structure) also taking in account the questions regarding expectation and perception (RQ1 and RQ3).

a) Quantitative Dataset - development and pre-testing of psychometric items

The psychometric items in the survey were developed as an initial measurement of DPI elements. It brings together the two DPI categories, PA and DS, derived from the literature (see Chapter 4). The survey constructs were built on the described elements of DPI and a pool of items was created for each category to tackle the construct meaning. Table 10 presents the DPI categories evaluated in this survey. The intended meanings of each category are provided in Appendix 2 (section 5.7.1).

Table 10. DPI elements measured in the survey for PA and DS

PA - Personal Attributes	DS - Design Skills
▫ Confidence	▫ Cognitive Abilities
▫ Emotion	▫ Cognitive Strategies
▫ Ethics	▫ Personal Communication
▫ Leadership	▫ Interpersonal Communication
▫ Openness	▫ Education (Knowledge)
▫ Responsibility	▫ Practice (Knowledge)
▫ Social Abilities	▫ Manager Competency
	▫ Project Management

In a second step, the survey's Likert-type scale items were developed to adapt the questions to the specific context of design activity. Based on the level of agreement with the items, the respondents indicated how much they identified their work activity with the pre-set statements related to daily practice in the context of design. A simple response scale measurement was used to allow faster responses and easier understanding of the items (Morgeson & Humphrey, 2006). A multi-item scale was necessary due to the expected small sample size within one category, in order to measure a weak effect within each category. Also, complex response scales have been shown to add substantial construct-irrelevant variance (Harvey et al., 1985). The development of specific items for this study was necessary since no previous models or sets of survey items were addressed to the specific focus in design.

The process of survey development involved careful instrument design, paying particular attention to the wording of the questions. Item choice, revision and writing were guided by prior definitions of each construct in the design literature. When creating new statements, several principles were used to construct items that: (a) reflected the construct definition; (b) were distinct from the other identified elements; (c) did not exceed a maximum length (20 words); (d) did not have an explicit measurement meaning. These principles are in line with Robson's (2011) and Rust & Golombok's (2009) suggestions for designing self-completion questionnaires. The developed items were tested on a pilot population. Based on this pilot stage, changes were made to improve the measures or clarify the items. The questionnaire contains positively-keyed and negatively-keyed sentences (referring to the opposite relation/meaning of the intent measurement) in order to reduce the effect of acquiescence bias (Furr & Bacharach, 2013). The development of the items comprising the psychometric assessment of awareness about the DPI elements attracted most of the revisions.

Survey development and pre-testing consisted of eight steps in which the items and the results were analysed and refined until the final variables were selected; these are presented and discussed in the following subsections. The psychometric survey items constitute the quantitative part of the dataset proposed in this chapter. Figure 5 illustrates all the steps of survey development and the details of data collection, refinements, and analysis.

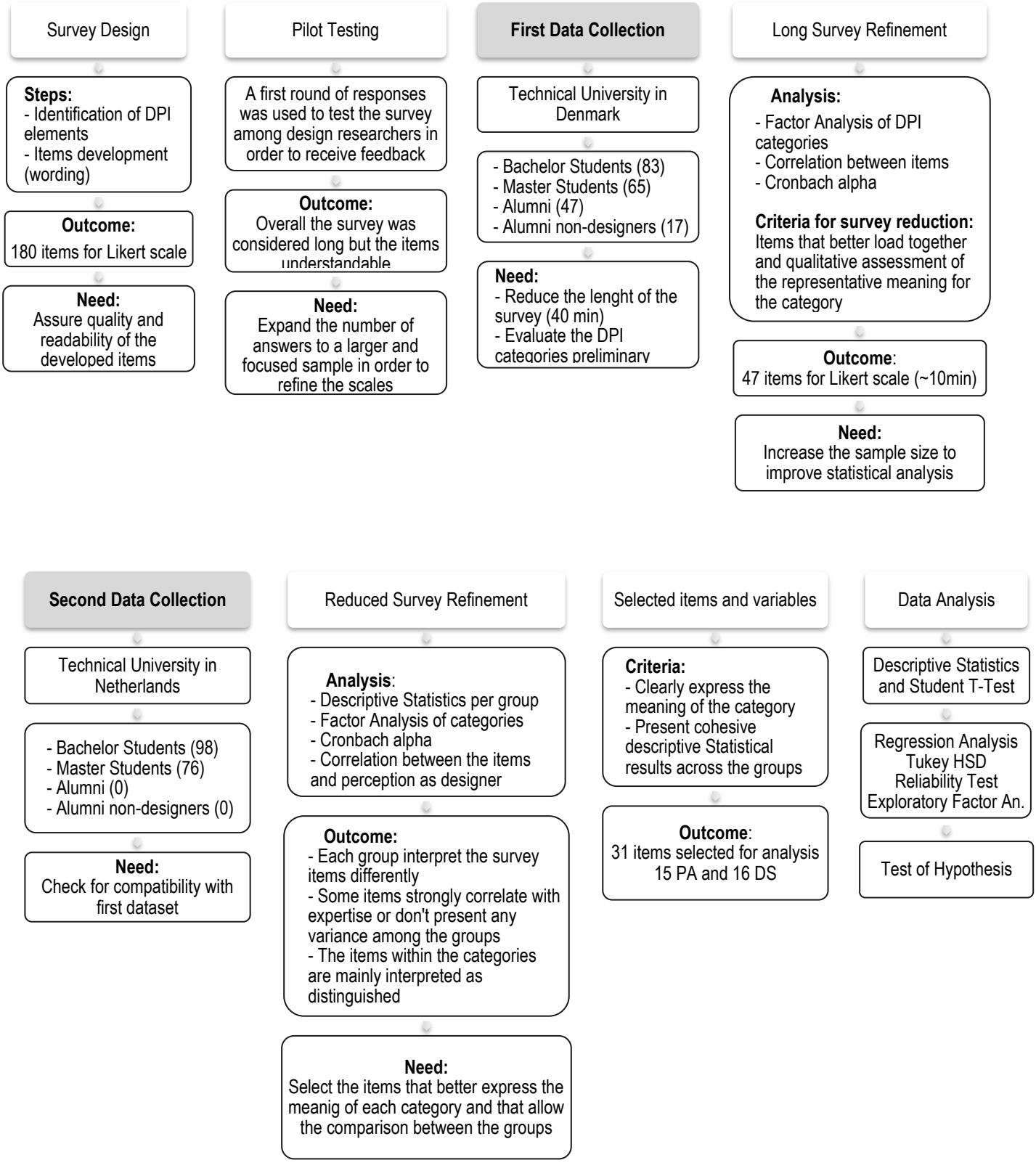


Figure 5. Method of survey development, data collection, and data analysis

After preliminary data collection, the survey went over a round of refinement in order to select the items that best expressed the meaning of each category and to reduce the time needed to fill the survey in order to increase the response rate. This resulted in 47 of the original 180 items being selected for the second data collection round. To achieve adequate internal consistency and reliability while maintaining a reasonable survey length (Morgeson & Humphrey, 2006), three items from the long survey were used to assess each element in the second data collection. Due to the heterogeneous nature of the responses, the DPI categories were not cohesive across the sampled groups. Thus, depending on the data and the representativeness in the category, the final analysis included fewer items (see Appendix 2, section 5.7.3). We conducted a second survey refinement round. Since the results of the analysis of the awareness of subjects about the DPI elements were inconclusive, the items were selected to provide the best fit with the meanings proposed in the literature and for statistical consistency.

Following the second data collection round involving Beginners and Intermediates, data compatibility was assured; both universities presented very similar pattern of responses with no significant differences for any category or group. The TU Delft alumni could not be accessed. In order to check robustness, the data were analysed using ANOVA, Tuckey HSD test, and Reliability test. The results are presented and discussed in Chapter 5, section 5.3.1.

b) Qualitative dataset – The open-ended questions

The qualitative part of the survey was developed in order to obtain deeper insights into respondents' motivations and triggers for pursuing a career in design. It aimed to explore initial concepts regarding professional characteristics and professional self-identification. The respondents were asked to explain briefly: a) why they chose design and what attracted them to this profession, b) why they decided to take another career path (for the drop-out alumni only), and c) what they consider to be the role of a designer.

According to Morelock (2017), the most common qualitative method for measuring identity is binary observation via tangible markers. Thus, the responses were coded using Axial coding and Thematic Analysis, to break down responses into core theme categories to further conceptualize new theoretical ideas and constructs (Kendall, 1999). The categories were examined for their integration and interrelationships with each other in order to provide initial insights into theoretical constructions related to social processes for the development of theory (Gioia, Corley, & Hamilton, 2012; Kendall, 1999).

The respondents were asked to report a measure of self-identification as a designer. The evaluation of how much they perceived themselves to be designers ranged from 0% to 100%, and is identified as the variable (how_much-designer). Descriptive statistics were used in all the steps of the analysis of this assessment in order to examine how and if values differed across the three levels of development (differences in mean scores, and standard deviation). A t-test was used to estimate significance among the score differences between groups.

The respondents were asked, also, to identify on a ranking scale, the importance of DS. The list of DS was derived from the literature (see Chapter 4) and included the same constructs evaluated in the qualitative dataset. The survey respondents ranked the DS elements from the most to the least important skill for a professional designer, which expressed their perceptions of the most required skills. Descriptive statistics were used in all the analysis steps of this assessment and the response means per edu-level group were quantified to obtain a picture of shifts in perceptions across groups.

5.3 Results

The outcomes of the survey are presented in sections: 5.3.1 - Evaluation of DPI elements and 5.3.2 - Evaluation of perceptions and role understanding, on which distinct analytical methods were applied according to the requirements of the type of data. Aspects of the proposed framework (Figure 4) are analysed for all three cross-sectional groups.

Section 5.3.1 first provides an assessment of the quantitative part of the dataset to evaluate the development of DPI elements over time, based on: *a) Descriptive statistics and initial analysis*, and *c) Statistical analysis of DPI elements and survey robustness checks*. Section 5.3.2 assesses the qualitative data to evaluate understandings related to the professional role and design career over time, based on: *a) Self-assessment on DPI, b) Ranking of DS elements, c) Triggering reasons to become designer,* and *d) Perceptions about the role of a designer.*

5.3.1 Evaluation of DPI elements

a) Descriptive statistics and initial analysis

To obtain some initial insight into awareness development over time, we conducted a coarse comparison of means across each DPI element for each of the groups in three levels of development: ***Beginners*** *(N=166)*, ***Intermediates*** *(N=121)*, and ***Professionals*** *(N=28)*. Table 11 compares the results of the sampled subjects within the three groups analysed (N = 326) for both PA and DS. We tested the differences between each group for their statistical significance. Drop-outs were used as the control group (N=11). The decrease in average scores in the drop-out group is indicative of the day to day disconnection from design practice despite pursuit of a design education. Low values can be expected in the case of drop-outs and indicate the situational awareness regarding PA and DS within the other evaluated groups.

Table 11. Descriptive Statistics of DPI elements

	Beginners (BSc) (N=166)			*Intermediates (MSc) (N=121)*			*Professionals (N=28)*			*Drop-outs (N=11)*		
	Mean	StEr	Var	Mean	StEr	Var	Mean	StEr	Var	Mean	StEr	Var
PA_Confidence	2,70	0,08	1,01	2,75	0,09	0,99	2,89	0,19	1,00	2,61	0,33	1,23
PA_Emotion	3,97	0,06	0,73	4,04	0,06	0,73	4,17	0,12	0,86	3,39	0,40	1,32
PA_Ethics	3,40	0,08	1,06	3,47	0,09	0,98	3,49	0,19	1,02	3,45	0,30	0,97
PA_Leadership	2,92	0,08	1,07	2,92	0,10	1,07	3,01	0,20	1,13	2,76	0,37	1,22
PA_Openness	4,04	0,07	0,89	4,16	0,07	0,83	4,26	0,17	0,94	4,15	0,35	1,34
PA_Responsibility	3,23	0,08	0,98	3,21	0,09	1,03	3,04	0,20	1,03	3,12	0,31	1,04
PA_Social Abilities	3,01	0,06	0,81	3,10	0,08	0,86	3,50	0,11	0,61	1,92	1,39	0,65
DS_Cog.Ability	2,96	0,08	0,97	3,04	0,09	0,96	3,27	0,18	0,96	3,18	0,31	1,06
DS_Cog.Strategy	3,34	0,07	0,94	3,36	0,08	0,90	3,68	0,15	0,96	3,79	0,22	0,78
DS_Per.Comm.	3,64	0,08	0,97	3,65	0,10	1,06	3,89	0,17	0,97	3,97	0,29	1,03
DS_Inter.Comm.	3,90	0,06	0,78	3,89	0,07	0,77	4,00	0,13	0,80	3,76	0,32	0,99
DS_Education	3,15	0,09	1,22	3,31	0,10	1,11	3,63	0,18	0,99	3,45	0,28	0,93

DS_Practice	3,50	0,08	1,08	3,05	0,09	0,95	3,74	0,17	0,88	3,62	0,34	1,16
DS_Manager	2,75	0,08	1,03	2,73	0,08	0,93	2,88	0,18	1,00	2,55	0,30	1,13
DS_Proj.Man.	3,48	0,07	0,97	3,50	0,08	0,87	3,57	0,18	0,96	3,70	0,25	0,88
Total	**3,33**	**0,07**	**0,97**	**3,38**	**0,08**	**0,94**	**3,54**	**0,17**	**0,94**	**3,30**	**0,38**	**1,05**

Differences between the levels

	BSc-MSc		***MSc-Prof***		***BSc-Prof***		***Prof-Dropout***	
	Diff (%)	Tt	Diff (%)	Tt	Diff (%)	Tt	Diff (%)	Tt
PA_Confidence	0,05 (2%)	0,89	0,14 (5%)	0,91	0,20 (7%)	0,80	0,28(10%)	0,67
PA_Emotion	0,08 (2%)	0,85	0,13 (3%)	0,78	0,20 (5%)	0,66	0,77(19%)	0,08
PA_Ethics	0,07 (2%)	0,86	0,01 (0%)	0,98	0,09 (2%)	0,87	0,03 (1%)	0,96
PA_Leadership	0,02 (1%)	0,92	0,09 (3%)	0,71	0,11 (4%)	0,57	0,25 (8%)	0,14
PA_Openness	0,11(3%)	0,24	0,10 (2%)	0,22	0,22 (5%)	0,10	0,11 (3%)	0,20
PA_Responsibility	-0,03(1%)	0,88	-0,17(6%)	0,51	-0,20(7%)	0,44	-0,09(3%)	0,81
PA_Social Abilities	0,08 (2%)	0,72	0,40(11%)	0,24	0,47(14%)	0,21	1,58(45%)	0,46
DS_Cog.Ability	0,07 (2%)	0,73	0,24 (7%)	0,23	0,31 (9%)	0,17	0,09 (3%)	0,48
DS_Cog.Strategy	0,03 (1%)	0,97	0,32 (9%)	0,64	0,34 (9%)	0,63	-0,11(3%)	0,86
DS_Per.Comm.	0,01 (0%)	0,96	0,25 (6%)	0,21	0,25 (7%)	0,03*	-0,08(2%)	0,56
DS_Inter.Comm.	-0,01(0%)	0,99	0,11 (3%)	0,80	0,10 (3%)	0,81	0,24 (6%)	0,58
DS_Education	0,16 (5%)	0,13	0,33 (9%)	0,04*	0,48(13%)	0,02*	0,18 (5%)	0,60
DS_Practice	0,02 (0%)	0,78	0,23 (6%)	0,86	0,25 (7%)	0,89	0,12 (3%)	0,76
DS_Manager	-0,02(1%)	0,83	0,15 (5%)	0,53	0,13 (5%)	0,60	0,34(12%)	0,35
DS_Proj.Man.	0,02 (1%)	0,95	0,07 (2%)	0,81	0,09 (2%)	0,68	0,13 (4%)	0,63
Total	**0,04** (1%)	**0,78**	**0,16** (4%)	**0,56**	**0,20** (6%)	**0,50**	**0,24** (7%)	**0,54**

Tt = Students' T-test (*p ≤ .05, or Significant Results) | Diff = Difference between the means

b) Statistical analysis of DPI elements and robustness checks

Due to the initial absence of significant results for the vast majority of the constructs, we conducted an exploratory analysis in order to evaluate the characteristics of the survey items related to DPI and the response patterns. This involved four main steps related to understanding and validating the scales.

First, we ran an ANOVA test to analyse the differences among the means for each group. The ANOVA results for all the psychometric items based on edu-level show significances lower than 0.05 for many items, which means that there were differences in the responses from the three groups. The complete ANOVA results tables are provided in Appendix 2 (section 5.7.4a).

Second, we applied a Tukey HSD test as a multiple comparison tool to explore differences in the means between the three groups and identify whether or not the differences identified by the ANOVA were significant. The complete Tukey HSD tables are provided in Appendix 2 (section 5.7.4b). The two tests showed no variation and, overall, the Tukey test was ineffective, indicating a reliability problem related to the psychometric items.

Third, we ran a reliability test to clarify the results of the previous two tests. The reliability test results were lower than 0.6, meaning that the data related to the psychometric part of the survey are neither consistent nor reliable and do not allow further statistical testing. The results of the reliability tests are provided in Appendix 2 (section 5.7.4c).

Finally, we ran an Exploratory Factor Analysis (EFA) to check for cross-loading values. Some survey items showed evidence of mutual annulment. This led to our decision to group the items within their original theoretical DPI category constructs, derived from the literature reviewed in Chapter 4. The

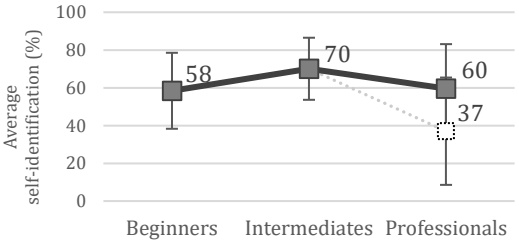
results did not allow further analysis. The complete EFA tables are provided in Appendix 2 (section 5.74d).

Based on these statistical tests, in relation to the responses to the psychometric items in the survey, we found lack of significance and consistency in these data. Thus, since the results of the psychometric survey items are inconclusive, the statistical tests do not provide additional knowledge and the RQ2 could not be addressed in this study. In the discussion that follows, we offer several possible explanations for this.

5.3.2 Evaluation of perceptions and role understanding

a) Self-assessment on DPI

A direct measure of professional self-perception was used to evaluate the average degree of self-identification of the respondent as a designer — addressing RQ 1. All the respondents were asked to estimate how much (as a percentage) they considered themselves to be designers. Figure 6 depicts the trend line for each group based on the mean values of self-perceived PI. The overall responses (N= 305) describe a non-linear development in terms of subjects' self-identification as designers. A significant and unexpected drop of around 10% is observed between intermediates and professionals, possibly reflecting the change from an education environment to a professional one at the end of the period of education, and integration (or not) in the job market.



	N	Mean (%)	St.Dev.		Diff. (%)	T-Test
Beginners	158	58,41	20,12	B – I	-11,66	0,000*
Intermediates	110	70,07	16,44	I – P	10,48	0,004*
Professionals	27	59,59	23,53	B - P	-1,18	0,392
Drop-outs	10	37,00	28,43	P - D	22,59	0,010*

Figure 6. Respondents' self-identification as Designers

b) Ranking of DS elements

When asked to rank the elements of DS in order of importance — addressing RQ3 —, the survey respondents showed differences in terms of their conception of an *ideal* designer. Thus, the perceived importance of skills highlights a challenge towards becoming a socially accepted as professional designer, as described in Chapter 4, section 4.1.2. Figure 7 depicts the different attributions related to the importance of DS for the three groups and the change in perceptions and expectations related to DS elements. The detailed results are provided in Appendix 2 (section 5.7.5).

Figure 7 shows that perceptions generally follow a progression from Beginners to Professionals, while cyclic shifts in attribution can occur. The perceptions on the importance of an element go back and forth over time such as the knowledge from education (EK) and from practice (PK). Some elements, such as CS and MC, show no progression, with importance remaining stable over time

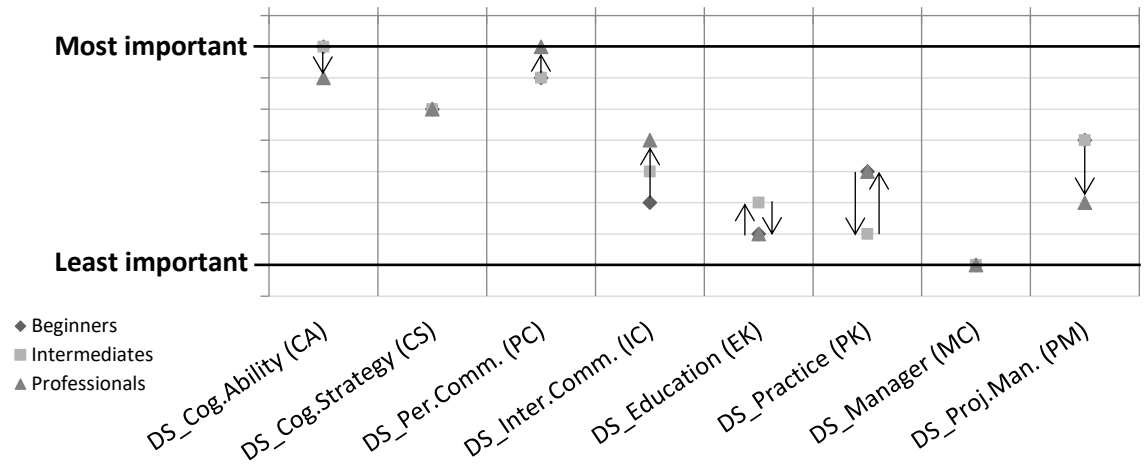


Figure 7. Changes in expectations based on the importance attributed to DS

c) Motivations and reasons for becoming a designer

Most of the initial anchoring of perceptions relies on personal interests and individual expectations regarding professional understanding. The respondents were asked to explain, briefly, why they had chosen the design profession (why-design) — addressing RQ4. The answers (N= 306) were classified by Axial Coding (Kendall, 1999) into five categories of reasons, providing an initial notion about the triggers for choosing a design education and career. The five categories are: (1) to apply creativity, (2) to combine skills, (3) to create impact, (4) to challenge intellect, (5) other. The categories are presented in Table 12 along with examples of coded sentences for each category. An example of the coding tables including the reasons given by Beginners (edu-level=1), are provided in Appendix (section 5.7.6). Table 13 presents the results for the quantification of extracts in each category, for each level.

Table 12. Description of categories and coding for the reasons to choose Design

Coded categories	Description of category	Examples of answering quotes
To apply Creativity (n=95)	Include quotes that express a motivation related to make use of creativity.	"Because I like to be creative, but didn't want to go to an art school" "Because I like to be innovative and to create something new" "Because I love being creative, working as well as thinking, and also make products for people (to make life better)"
To combine Skills (n=61)	Include quotes that express a motivation related to make use of multidisciplinary competencies.	"Because of the varied set of competences needed" "Because I like the combination of the different aspects like creativity, technology and management. Also I think it's nice how we can help people and improve the world through design" "Because I am half creative and half technical, and the combination of this two in product/industrial design is very interesting. I like that design has many different areas and you need to know about different expertises to tackle the whole design process"

To Create Impact (n=50)	Include quotes that express a motivation related to make a contribution to society and create positive impact.	”Because it is interesting to create a product which is appreciated by customers and really can make a difference” ”Because I want to make the world a better place and I like the way I can express my creativity through industrial design” ”Because I wanted to be able to tackle problem situations with remarkable solutions [and] express them in a different way [of] conveying a Message through a product/service solution that inspire people”
To challenge intellect (n=57)	Include quotes that express a motivation related to challenging intellectual capabilities such as defying logic and problem-solving.	”Because I like to express myself creatively and I am very interested in the logic behind products” ”Because it has a balance between technics and creativity on a challenging level” ”Design is a way of thinking and a way of problem solving for me. Its application is not limited to "designing" something tangible. It can be used in all aspects of life. Hence I chose a career in design”
Other reasons (n=45)	Include quotes that express a motivation related to reasons not included in the previous categories such as personal and psychological aspects.	”Sounds fancy” ”Because my grandfather was a designer at Ahrend and he had such amazing projects and fun that I wanted to do that as well” ”It was close to an inventor profession”

Table 13. Quantification of coded reasons for choosing Design per group

	Beginners **(edu-level=1, n=155)**	Intermediates **(edu-level=2, n=110)**	Professionals **(edu-level=3, n=25)**	Drop-outs **(edu-level=4, n=9)**	Total
To apply Creativity	61	29	4	1	95
To combine Skills	32	25	4	0	61
To Create Impact	26	17	5	2	50
To challenge intellect	23	19	4	1	47
Other reasons	13	19	8	5	45

As perceptions and motivations change over time, some graduates drop-out of design – sometimes after completing the whole of their design education programme. Respondents identified as drop-outs were asked to provide a brief explanation for why they had decided to pursue another professional activity (why-dropout). The responses (N= 17) clarified why graduates decided to change career paths after completing a professional education. This adds to our understanding of the demotivations and professional identification issues related to design as a profession. Table 14 presents the coding of the responses from the drop-out group in relation to: demotivation triggers and PI issues. The categories are summarized and accompanied by examples of coded sentences for each category. The complete table of reasons offered by the surveyed alumni is provided in Appendix 2 (section 5.7.7).

Table 14. Coding examples of drop-outs reasons for changing career path

Coded categories	Description of category	Examples of answering quotes
Demotivation Triggers (n=8)	Include quotes that express a reason to drop-out that is related to demotivation. This category is presented into two subcategories: New interests (n=3) and Lack of Jobs (n=5)	"During my student jobs and internships I discovered a passion for the commercial/business side of things which pulled me in that direction. Personally, I felt the hard-core design stuff became to nitty-gritty and too theoretical and out of touch with the real world. When I didn't think stuff we were doing would survive in the real world my motivation disappeared." "I couldn't find any job and I was working as a freelance graphic designer which is somehow frustrating after some time, especially dealing with clients that always delay the payment. Since I was supposed to live thanks to my job I was forced to switch to other random jobs."
Professional Identification issues (n=9)	Include quotes that express a reason to drop-out that is related to a lack of professional identification. This category is presented into two subcategories: No design-related daily activities (n=5) and Design terminology & roles (n=4)	"It depends on the definition of design. I work with User Experience Research, which is more research and IT development related than design. I use many principle from design, but I am not strictly working with it (much more with data analysis and programming)" "Got tired of having to always explain to companies that I wasn't a fashion designer. / The general line of study at uni felt too undefined and uncertain. I could take all the same courses but feel more "respected" for potential workplaces with another master. / A student job took me from design to ERP implementations"

d) Perceptions about the role of designer

Overall perception and understanding of the professional designer role are related to the dynamics of DPI development and its significance for individual confidence and professional development. All the respondents were asked to explain briefly how they saw the role of a designer (role-designer). Their responses (N= 396) can be categorized according to four different aspects: (1) project-driven, (2) creativity-driven, (3) customer-driven, (4) impact-driven. The categories are defined in Table 15 along with examples of coded sentences for each category. The coding tables with examples of the quotes from the Beginners (edu-level=1) are provided in section 5.7.8. Table 16 present the results based on quantifying the quotes in the categories for each development level.

Table 15. Coding examples of responses about the Role of Designers

Coded categories	Description of category	Examples of answering quotes
Project-Driven (n=112)	Include quotes that express a designers' role as related to problem-solving and to the operationalization of a project.	"The role of a designer is to connect every person of different discipline together, to make a good functioning project" "The role of a designer is about connecting people with all kinds of skills to make a project a complete and solid product." "The role of the designer is to be a problem solver. Sometimes through Innovation. But first and foremost a problem solver!"

Creativity-Driven (n=76)	Include quotes that express a designers' role as related to creative development.	"To create and invent new technology or to improve/redesign already existing designs" "To create new solutions for existing and/or unidentified problems by using creative methods." "To create things that work, with deep empathy for the user and an understanding of the tech needs and business needs"
Customer-Driven (n=62)	Include quotes that express a designers' role as related to improving customer satisfaction and users' lives.	"To create solutions to problems that affects the lives of people, in a way where people will use and implement the solution" "In my opinion, the designers' role is to design products that solve problems and give value to the users in the specific context they are designed for. The designers' role is to connect the user with technology, materials and opportunities." "To translate needs for users to acceptable, affordable and available solutions"
Impact-Driven (n=36)	Include quotes that express a designers' role as related to provide innovative solutions that can contribute to improving society and create impact.	"The role of a designer is to improve living on Earth by providing products, systems and other things while considering all parties that are relevant." "Visionary trying to make the world a little better, today and tomorrow. Trying to find service/product solutions to everyday problems users/companies encounter" "The main role is to understand the present and to re-imagine the future"

Table 16. Quantification of coded quotes, for each group, for reasons for choosing Design

	Beginners **(edu-level=1, n=150)**	Intermediates **(edu-level=2, n=107)**	Professionals **(edu-level=3, n=24)**	Drop-outs **(edu-level=4, n=10)**	Total
Project-Driven	53	46	8	5	112
Creativity-Driven	43	25	6	2	76
Customer-Driven	33	20	7	2	62
Impact-Driven	18	16	2	0	36
Other	3	2	1	1	7

5.4 Discussion

This study aimed to investigate DPI development over time based on Education, Awareness, Expectation and Motivation – from the beginning of the design education to professional positioning as a designer. The objective was to provide some initial insights into DPI, as a developmental aspect, and the influences of professional self-perception, i.e., awareness, professional expectations and motivations for studying and practising or leaving design. The study addressed four research questions.

In the first research question was: **Does subjects' self-identification and awareness as designers (DPI) increase over time?** To evaluate self-perception for each group of respondents, we assessed

the level of self-identification (section 5.3.2). The data were analysed based on descriptive statistics and linear regression. The results show that is possible to assess progressive changes in professional self-identification using a direct measure of self-evaluation related to the cross-sectional characteristics used in the survey (section 5.2). The results presented in section 5.3.2 show the expected progression of DPI scores over time during the period of education (between Beginners and Intermediates), which is in line with the theory (see section 5.1.1). We observed a significant decrease of around 10% for the transition from intermediates to professionals. Garner (2005) suggests that the education process allows gradual exposure of students to the complexities of the discipline, primarily via project work whose difficulty increases over the years of education and can have a direct influence on whether students perceive themselves as competent and able to formulate good solutions (Vignoles, 2011). Also, Dreyfus (2004a) discusses the tensions at the Intermediate level, due to the increased complexities and psychological pressure related to expectations and recognition. These tensions can lead to a PI crisis, identified in psychology as a *moratorium period* (Skorikov & Vondracek, 2011). It has been shown that delayed professional self-identity can be a barrier to the successful transition from student to professional (Crossley & Vivekananda-Schmidt, 2009; Godsey, 2011).The shifts in perception identified show the effect, over time, of the importance attributed to the different DPI elements that potentially increase the tensions.

Perceptual changes can disrupt the linear construction of a PI (see section 5.1.1), especially during transition periods, and is expressed as lack of confidence and poor self-identification as a professional (Lewis & Bonollo, 2002; Oxman, 1999; Robinson et al., 2005). The results for the drop-out group showed that unexpected shifts are possibly caused by the different environment at the end of education and the challenges related to integrating (or not) in the job market. Further investigation is needed to refine this assumption and the measures used in this study. A direct measure of the understanding of the professional role and challenges during transition periods, could provide insights into the factors that promote shifts in perceptions in different environments. Also, the challenges and career uncertainties faced at transition periods could be quantified to identify the factors that tend to promote shifts in perceptions.

The second research question was: **What is the role of education in DPI development?** This was addressed by conducting a quantitative assessment of the DPI elements PA and DS to evaluate awareness; it was facilitated by the inclusion of psychometric questions scored on a 5-point Likert scale (section 5.2.2). The data were analysed using descriptive statistics, ANOVA tests, Tuckey HSD, a reliability test and EFA. The results in section 5.3.1 show that the instrument needs some refinement, despite the measures being subjected to pre-testing. It was not possible to identify significant differences among the three groups of respondents or to derive any categorical assumptions. Although the psychometric items in the survey did not deliver the data needed to address all of the research questions in detail, the results obtained provide a starting point in the evaluation and measurement of DPI and the complex nature of identity . Research in several fields supports the idea of PI construction as a critical and formative process that occurs during an education programme and continues throughout a lifetime of practice (Skorikov & Vondracek, 2011), during which perceptions and understandings of reality change (Berzonsky, 2011). Two potential reasons for our inconclusive findings are discussed below, together with suggested improvements and possibilities for further work.

The first reason is related to nature of the concepts since the two categories of DPI elements, PA and DS, are derived from combining elements identified in the current DPI literature and theory (see Chapter 4). The descriptions of these constructs in the literature vary. Consequently, few measures have been operationalized for this type of study. Many of the elements measured in the survey, especially those related to DS, are more commonly assessed via individual experiments (Shah et al., 2009). Other authors have studied these elements in more practical ways (e.g., Lewis & Bonollo, 2002; Shah et al., 2012), focusing on actual outputs rather than awareness. Further, Cowin et al. (2013), in their study of PI measures, evaluated five prominent methods for a sample of first to third-year nursing students. However, they were unable to identify a psychometrically strong tool to measure PI due to problems such as theoretical conception, measurement aims and model construction, which showed no significant differences in mean scores across groups. Morelock (2017) identifies only six studies that try to use quantitative instruments to measure engineer identity and highlights that it appears to be a recent activity and instruments are still in the stages of development and refinement. Similarly, the method used in the present work is primarily exploratory and is aimed at providing an operationalization of the measurement of DPI elements identified in Chapter 4. Given the relatively imprecise nature of the descriptions in the current design literature and the difficulty related to their operationalization in this context (Cowin et al. 2013), our results are perhaps less surprising. Further, research could try to assure the reliability of PA measurements through the use of a recognized personality test to allow triangulation of respondents' data. Parallel studies also would allow triangulation to assess practical elements and evaluate whether good practical results affect individual self-perception or self-identification as a professional.

Second, although psychometric survey assessment is a well-established method for evaluating PI (Worthington et al., 2013), it can be seen as a preliminary method is our context, since it indicates only the level of awareness of the subject in relation to a particular topic (Cowin et al., 2013). Thus, the respondent might be unaware of certain elements or, due to the complexity described in the design literature, be unable to precisely identify a meaning for "*fuzzy*" concepts (Zadeh, 1965) such as creativity or emotion. Thus, further work could focus on the uniqueness of respondents or on identifying a cohesive definition of the constructs (Kahraman et al., 2016). Hesketh et al. (1988) suggest use of fuzzy logic or a fuzzy rating-scale to allow more accurate assessment of human individuality because responses are both elicited and represented as alternatives, or use of a range of scores. Álvarez et al. (2015) compare use of Likert and Fuzzy Rating Scales (FRS) to cope with the imprecision of human thought and experience when measuring attitude. The scattered characteristic of the dataset and the statistical limitations of the present study, highlight both the uniqueness of individual perceptions and the broad comprehension of the constructs. Another difficulty related to assessment of the development of DPI categories over time, is that the method does not constitute a traditional longitudinal study, but rather a cross-sectional picture of respondents at different levels: Beginner, Intermediate, and Professional. Further work could aim at achieving a deeper understanding of the reflections of self-perception and expectations development towards DPI, through an in-depth qualitative study. This would enrich the literature by pointing to nuances and interpretations in the operationalization of the measures and revealing respondents' understanding of their design role and design values, within a contextualized approach involving peer rating triangulation. Further, use of a FRS could provide a new quantitative approach to the operationalization of the DPI measures.

The third research question was: **What are the expectations regarding Design Skills related to the professional designer?** We ranked the importance of DS elements in relation to the ideal designer to evaluate the expectations of each group of respondents (section 5.3.2). The data were analysed using through descriptive statistics and comparison with the literature. The results show that shifts in perception follow a progression from Beginners to Professionals, while cyclic attributions occur when perception of importance changes over time. The attribution of some elements remains fairly stable over time (section 5.3.2). The evolution of self-perception and expectation reflects adaptation to the most valued elements identified in the design literature (see e.g., Lewis & Bonollo, 2002; Oxman, 1999; Robinson et al., 2005). Luyckx et al. (2011) shows that a balance between accommodation to expectations and professional awareness is necessary for the development of a mature, flexible and coherent identity.

Changes in perceptions and understandings over time have been shown to result from the education and training process (Markauskaite & Goodyear, 2014) during which DS elements develop dynamically as the result of the accumulation of knowledge and different learning processes (Dreyfus & Dreyfus, 2005). This change in expectation was shown to be connected to the level of awareness about DS and changes in the understanding of the professional role of designer. Including PA elements in DS, as regulator factors in the alignment between awareness and expectation, could provide a broader overview on expectations; once PA elements tend to carry out the tacit assumption of immutability, changing slowly as a function of social context and behavioural reflection (Yılmaz et al., 2015). Further investigation is needed to understand the contributing factors affecting the shifts in perceptions and to refine this assumption. Hence, further work could include controlled evaluation of each DPI element to provide a deeper understanding of PA and DS as separate aspects. Future studies, also, could examine the effect of social-perception and evaluate the contextual aspects contributing to awareness and self-perception. Furthermore, the roles of environment and professional transitions could be explored more deeply in the context of self-identification shifts.

The fourth research question was: **What is understood as the role of a Designer and the motivation for choosing this profession?** To address this question, we posed qualitative open-questions to evaluate motivation and professional understandings, for each group of respondents (section 5.3.2). The responses constitutes the qualitative dataset of the survey, where the respondents described their motivations for choosing a design education , and their understanding of the professional role of designer. The data were analysed using axial coding and qualitative thematic analysis. The results show that the exploratory nature of these questions allowed a mapping of initial insights regarding the professional characteristics that attract students and some specific reasons for dropping-out (section 5.3.2).

The thematic analysis revealed four main reasons why the respondents chose to invest in a design education. The two biggest categories were desire to apply creativity and to develop new solutions. These results confirm the proposal in Wang & Ilhan (2009) that creative acts are at the centre of 'sociological wrapping' and permeate all the layers of "design profession" to establish a PI. This knowledge adds value to the study of professionalism in design by structuring the main characteristics on which DPI relies, based on the interest in and motivational aspects of this profession. Further studies could evaluate the strength of these two categories in relation to professional expectations,

and the psychological impact of mismatches that occur when students do not perceive their activities as in alignment with these expectations.

The themes distilled from the survey about the role of a designer were: project-driven, creativity-driven, customer-driven and impact-driven. These categories encompass many of the aspects identified by Morelock (2017). Most respondents saw the role of a designer as primarily project-driven, with creativity aspects ranked also fairly high. Design is recognized as a constraint-intensive domain in which creativity is important (Cross, 1990; Onarheim, 2016). Thus, individual understanding regarding the designer's professional role was identified as a fundamental factor in DPI since it determines a range of expectations regarding professional activities, which, combined with situational awareness, can affect confidence and self-identification. The responses from the drop-out group suggested demotivations such as 'changing or developing a new range of interests', 'lack of job opportunities in the field at the end of education', and 'professional identification issues'. Trede (2012) emphasizes that university education as preparation for practice, can encourage development of a professional identity, but does not provide a holistic picture of practice or the capacity to perform well in a socially situated and contextualized environment. Thus, despite the assumed expertise gains over time (Ahmed, 2007), the effects of context, career opportunities and situational awareness seem to be important for DPI. The categories derived from this study, despite the inconclusive quantitative results, provide some direction for further examination of the major DPI elements. In particular, they highlight potential themes that could be investigated and defined, to add to our understanding of designer identity.

Our results are in line with the two main groups of theories about PI development (Dehing et al., 2013). The first group emphasizes the importance of social embedding and communities of practice (Wenger, 1998a); the second assigns acquisition of identity to active experimentation with professional roles (Dehing et al., 2013; Ibarra, 1999), i.e., observation of role models and/or experimentation with provisional selves, supported by reflection and external feedback loops (Zou & Chan, 2016). Although it has been shown that social, demographic and personality factors contribute to and affect identity (Crossley & Vivekananda-Schmidt, 2009; Dobrow & Higgins, 2005a), this study focused on the individual and his or her perceptions, but did not actively consider social influences such as peer recognition and professional network.

By approaching self-perception and expectations as elements that reflect awareness and contribute to PI, this study extends prior conceptualizations of career development (i.e., Carmel-Gilfilen & Portillo, 2010; Yang et al., 2005) and adds to the literature on the process of becoming a professional designer (Adams et al., 2011; Dall'Alba, 2009; Dannels, 2000; Wells et al., 2009). Thus, despite inconclusive quantitative results the qualitative themes set a path for further in-depth refinement of the constructs related to the DPI elements and the importance of understanding expectations and motivations as part of professional identity development. The results and discussions suggest investigation of what DPI means in different contexts and for different stakeholders involved in design education and practice. Further work could consider in-depth evaluation of the relation between professional expectations and situational awareness to further understand the dynamics of professional self-identification in different environments. Future studies also could evaluate the impact of broader social factors, such as the construction of professional networks and peer and social recognition, in current operationalizations of DPI measures of awareness of PA and DS. This would help to refine the

measures in the proposed method by accounting for self-benchmarking with a peer group. These investigations would provide more understanding of the relations and influence of self- and social-perceptions on PI.

5.5 Conclusions

In this chapter, Designers' Professional Identity (DPI) was investigated in relation to the development over time of social and individual aspects of professionalism, based on Education, Awareness, Expectation and Motivation, and supported by Personal Attributes (PA) and Design Skills (DS). The study made use of a specifically designed survey to allow quantitative and qualitative cross-sectional comparative analysis. The development of DPI was discussed along with a first overview of the designer's role understanding and professional triggers. The results of the quantitative data from the survey was inconclusive, while the qualitative responses indicated development of self-awareness and DPI during higher education with a critical shift at the transition to the professional level. Other qualitative measures provided initial insights into the triggers that lead students to join or drop out of a design career path.

Perceptions and DPI within the groups were expected to follow a linear progression over time due to expertise development. However, DPI was shown to be rather dependent on contextual factors that support identity, and on the alignment between professional expectations and situational awareness. The assessment of the three levels of development provided valuable insights into the progression and possible changes in a designer's self-perceptive mind-set and self-identification over time. Based on these findings, this initial study has a number of implications for future work in this area. First, the general constructs adopted in this study were recognised in all the groups, supporting the importance of the elements identified in the literature and the need for further refinement of these constructs as measures. Although this is an exploratory study, the results suggest several promising measures that could form the basis for their further operationalization in this context. Second, the issues related to operationalization of a quantitative instrument to evaluate PI point to the limitations of quantitative methods to analyse wicked or fuzzy concepts and highlight the need for more extensive study and further qualitative analysis to allow a more refined understanding of the underlying constructs. In particular, the inconclusive quantitative results point to the need for further conceptual refinement and clarification in the design literature. Third, since PI relies on personal understandings and individual triggers, perceptions regarding professional role and developmental expectations could be better assessed quantitatively in a more extensive in-depth study. Fourth, it seems that social factors play an important part in shaping self-perception and subsequent research to operationalize the DPI measures should take account of this.

The study contributes to work on professionalism in design by attempting a first operationalization of measures of awareness in relation to DPI elements in different periods of the designer career, and mapping aspects of the evolution of self-identification, role understanding, motivations and professional expectations. This study should provide a motivation for further work to provide a better understanding of design professionals and the transition from Beginner to Professional. In particular, the findings reported here suggest the need for a greater focus on shaping professional expectations early in design education in order to mitigate substantial misalignments that could affect the periods of transition in a design career.

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5.7 Appendix 2

5.7.1 Description of meaning for DPI categories

Personal Attributes	
Confidence	*Certitude of its own personal abilities and professional competencies, being able to embrace innovative ideas and to start challenging projects, justifying own beliefs and (ethical) work.*
Emotions	*Sensitivity to external inputs, self-awareness and management of personal feelings, also related with moral and empathetic aspects.*
Ethics	*Awareness and positioning about any possible environmental, social, health or design life performative consequences, or lack of compliance to legislation.*
Leadership	*Sense of autonomy and managerial attitude, searching and promoting ideas among strategy and business view together with peers guidance and inspiration.*
Openness	*Acceptance and embracement of new and unusual ideas or methods, being able to deal with uncertainty and to make changes on the work plan by relying on the ability to improvise and remake. Also refers to capacity to deal with different topics and to work with people from different cultures, ideologies or beliefs.*
Responsibility	*Willingness to learn and to assume responsibilities from mistakes, conscientiously assuming risks, taking care of project details, deadlines, and working within own beliefs.*
Social Abilities	*Perceived facility on the exchange of tacit knowledge via joint activities: being together, living in the same environment, sharing experiences, and transferring ideas to other people.*
Design Skills	
Cognitive Abilities	*Capacity of think 'designerly'; understanding the nature of the problem to be solved; developing a distinct way of thinking about the problem and solution spaces; demonstrating high level of abstraction for idea generation and evaluation rounds.*
Cognitive Strategies	*Ability to set strategies of learning, problem framing, solution development, and problem solving that allow the flow of the cognitive abilities.*
Personal Communication	*Capacity to communicate clear and directly, attending to details and empathizing with audience.*
Interpersonal Communication	*Awareness of communication ability in order to make public presentations, set collaborations, establishing rapport, and communicate among a team.*
Education-based Knowledge	*Awareness of basic and specialized knowledge in design that compounds the formal education, and domain of technical and design language.*
Practice-based Knowledge (know-how)	*Abilities based and developed through practice, expertise and know-how gain. Such as good imagination/representation, IT competencies and use of software, negotiation capacity, and appliance of previous knowledge.*
Manager Competencies	*Perceived competence for managing generic tasks, in a personal level and with the colleagues or among the team.*
Project Management	*Competence in developing and managing the project such as planning, progressing among the tasks and phases, and evaluating effectiveness and outcomes.*

DTU Management Engineering
Institut for Systemer, Produktion og Ledelse

Introduction

This survey is part of a PhD project that aims to explore how a **Designer's Professional Identity (DPI)** develops. The intent of this study is create a holistic understanding about this construction process over time through psychological and educational aspects.

All the answers are anonym so please answer honestly and complete all the questions. It will take you **around 15 minutes** on the questionnaire.

If you would like to give us feedback, there is also a link on at the end. We are grateful for your support -- this research is not possible without the participation of people like you!

Terms of participation and confidentiality:
Your participation in this study is completely voluntary. All your answers are preserved by anonymity and will be stored as protected data.

Please start with the survey by clicking on the Next button below.

Demographic and Context

Q1) Demographic mapping:

Age	
Nationality	
City where you are living/working/studying	

Q2) What is your gender?

Male ○ Female ○ Other ○

Q3) What is your relationship with Design?

- ☐ I'm a 1st year bachelor student
- ☐ I'm somewhere in the middle of my Bachelor
- ☐ I'm on my last year of Bachelor
- ☐ I'm a master student
- ☐ I'm PhD / Post-Doc
- ☐ I have my own company of Design
- ☐ I'm a designer in a company

What is your line of education? (e.g. Design & Innovation, Product Design, Visual Communication)

From TU DELF	
From other University (Which?)	

In which semester of your studies are you? (relative to the curriculum)

What is your field?

(You can insert also your course or department, or what you mostly work with)

What is your previous education?

	(Check the box)	in what? (wright down)
Technical course	☐	
Bachelor	☐	
Masters	☐	
Post-Graduate	☐	
Other	☐	

Do you have work experience with design?

Yes ○ No ○

How much experience do you have working with design?

(Working in companies or with professional autonomous projects)

None	Less than 1 year	1 year	2 years	3 years	4 years	5 years	6 years	7 years or more
○	○	○	○	○	○	○	○	○

Do you have some experience working in companies?

- ☐ No
- ☐ Yes, I have some experience.
- ☐ Yes, I'm also working in a company part-time.

How big is the company where you work? *(leave blank if you are not working)*

0-50	50 - 100	100 - 250	More than 250 employees
○	○	○	○

Q4) Select the choice that better describes you.

	Strongly agree	Agree	Disagree	Strongly disagree	I'm not sure
People understand when I try to explain an idea	○	○	○	○	○
I don't like to be the center of attention	○	○	○	○	○
I connect ideas from many sources	○	○	○	○	○
I try to identify areas for improvement	○	○	○	○	○
I think about the impact of my design to others	○	○	○	○	○
It is hard to organize myself to accomplish all the tasks in a project	○	○	○	○	○
I don't use visual resources in my presentations	○	○	○	○	○
I pay too little attention to details	○	○	○	○	○
I am more capable than most others	○	○	○	○	○
I concern about the quality of my work	○	○	○	○	○
I wait for others to lead the way	○	○	○	○	○
I feel afraid of sharing my knowledge and people take my ideas	○	○	○	○	○
It is hard to create a new concept by associating different ideas	○	○	○	○	○
I know how to improvise	○	○	○	○	○
I am not a good manager	○	○	○	○	○
I don't like to manage my colleagues when it's not my role	○	○	○	○	○

Q5) Rank which of these elements do you think is more important for a designer.
(1 = most important, 8 = least important)

Interpersonal Communication skill (eg. Adequate presentations, Collaboration, Rapport establishment)
Educational Knowledge (eg. Language competencies, Basics about design, Focused topics of design)
Cognitive Strategies (eg. Learning strategies, Problem framing, strategy for problem solving, etc)
Personal Communication skill (eg. Communicate clearly and directly, attend to details, empathy with audience)
Manager competencies (eg. Managerial skills: time, colleagues, groups; to manage job-related tasks)
Cognitive Abilities (eg. Thinking deep, evaluting the problems, abstacting, etc)
Practice Knowledge (eg. Negotiation competencies, IT skills, Representation capacity, knowledge appliance)
Project Management (eg. Planning the project, Controlling development, Measuring Effectiveness)

Q6) Choose the option that comes closest to you. Spontaneous answers are the best.

	Strongly agree	Agree	Disagree	Strongly disagree	I'm not sure
I am shy to present my ideas	○	○	○	○	○
People can understand my reports even when they are not from my field (q_6)	○	○	○	○	○
I feel responsible for my creations	○	○	○	○	○
I prefer to have someone that orients me with my work	○	○	○	○	○
Usually the mistakes are not my fault	○	○	○	○	○
I don't like to spend time creating unneoessary alternatives (q_5)	○	○	○	○	○
I'm bad in evaluating the best and worst case scenario	○	○	○	○	○
I don't feel responsible for the product after deliver the project	○	○	○	○	○
I am interested on the entire chain that supports my product development	○	○	○	○	○
It is not easy to find the key elements in a problem/solution/design	○	○	○	○	○
I try to organize my ideas systematically	○	○	○	○	○
I like to think about the concept before start the designing process	○	○	○	○	○
I am not good at doing detailed research on the design	○	○	○	○	○
I find it easy to create visualizations of a concept	○	○	○	○	○
I don't like to use a text-book method	○	○	○	○	○
For me design is all about aesthetic expression	○	○	○	○	○

Q7) Do you have any experience leading groups?

Yes	Not sure	No
○	○	○

Please fill in the table bellow about your leadership experience.

	Where?	For how long? (years)			
	*	-1	1-5	5-10	10+
Work	☐	○	○	○	○
University	☐	○	○	○	○
Other	☐	○	○	○	○
I'm a manager	☐	○	○	○	○

Q8) Choose the response that best represent how you see yourself.

	Strongly agree	Agree	Disagree	Strongly disagree	I'm not sure
Usually my colleagues are motivated by my attitudes	○	○	○	○	○
It is difficult to judge the intentions behind a design	○	○	○	○	○
It is hard recognize and identify the main authors and methods in my field	○	○	○	○	○
I try to change my working environment in order to improve my effectiveness	○	○	○	○	○
I look for better ways to do things	○	○	○	○	○
I prefer to move forward than be questioning decisions	○	○	○	○	○
Usually I am good with public speaking	○	○	○	○	○

	Strongly agree	Agree	Disagree	Strongly disagree	I'm not sure
Accomplish the deadline is more important than the details to be correct					
My previous experiences help me to improve the quality of my work					
I can't see the project fails until its done					
I don't like to work on risky projects					
I think it's important to bond as a team					
I am good at using the software needed for my job					
I am not good with technology					
I am not good at negotiating with the client (q_2)					

Q9) Which software do you work with?

	Rate your skills					How did you learn it?		
	I know nothing	Basic	Intermediate	Advanced	Pro	by myself	on a course	at University
Microsoft/Open Office (Word, Excel, Power Point)								
Vector Software (Corel Draw, Illustrator)								
3D Modelling (Solid works, 3D Max, Maya, etc.)								
Technical Drawing (Autocad, Pro-Engineering)								
Other *								

Is it a specific one? which?

Motivation and Understandings

Q10) In your opinion, what is the role of a designer?

Q11) Why did you choose Design?

Q12) What attracts you in this profession?

Q13) How much do you identify yourself as Designer?
(0 = I don't consider myself as being a designer / 100 = Very hard)

0 10 20 30 40 50 60 70 80 90 100

Q14) How do you see your career until now?

Q15) What do you expect for your career on the next 2 years?

Thank You!

Thank you for answering this survey!

You finished the survey and we are really thankful for your time to help us on this research.

All your answers are preserved by anonymity and will not be shared with anybody.

If you want to receive your feedback please add your e-mail bellow. It can take a few days for us to analyze your data and send you an interpretation.

e-mail

If you would like to receive a followup about this study and be part of a longitudinal research please insert your contact bellow. (The longitudinal research will ask you to run this survey again next year)

Full Name

If you have any suggestion, comments, critics or something you think should be improved on this survey just let us know!

5.7.2 (cont.) Survey Structure and Coding schemes

	Question	Variable name	Measure unit	Coding
Demographics	*(Demographic field)*	Age	Years	-
	(Demographic field)	Nationality	Country	-
	What is your gender?	Gender	Category	1 - Male 2 - Female 3 – Other / not identify
	(created category for analysis)	Edu-level	Category	1 - Beginner 2 - Intermediate 3 - Professional 4 - Drop-out
	What is your relationship with design?	Education	Title	1 - 1st BSc 2 - middle BSc 3 - Last y BSc 4 - MSc 5 - PhD/Post-doc 6 - Prof/Researcher 7 - Designer (alumni) 8 - non-Designer (alumni)
	Do you have some experience working in companies?	working-company-dummy	Yes/No	0 - no 1 – yes
	Do you have work experience with design?	experience-dummy	Yes/No	0 - no 1 – yes
	How much experience do you have working with design?	experience-time	Years	0 - none 1 - less than 1y 2 - 1y 3 - 2y 4 - 3y 5 - 4y 6 - 5y 7 - 6y 8 - 7+
	How big is the company where you work?	Company-size	Category	1 - 0-50 2 - 50-100 3 - 100-250 4 - 250+ employees

Psychometric items	*(See Chapter 5, section 5.7.3)*	(DPI Categories)	5-points Likert Scale	Quantitative Analysis (statistics)
Ranking DS	*Rank which of these elements do you think is more important for a designer*	Cognitive Abilities	Rank-CogAb	(1 to 8) 1 = most important 8 = Least important
		Cognitive Strategies	Rank-CogStr	
		Personal Communication	Rank-PerComm	
		Interpersonal Communication	Rank-InterComm	
		Knowledge from Education	Rank-EduKnowl	
		Knowledge from Practice	Rank-PractKnowl	
		Managerial Competencies	Rank-ManComp	
		Project Management	Rank-ProjMan	

(cont.)	Question	Variable name	Measure unit	Coding
Open Questions	*In your opinion, what is the role of a designer?*	role-designer	Open text	Qualitative coding (categories)
	Why did you choose Design?	why-design	Open text	Qualitative coding (categories)
	What attracts you in this profession?	attracts-design	Open text	Qualitative coding (categories)
	How do you see your career until now?	career-now	Open text	Qualitative coding (categories)
	What do you expect for your career on the next 2 years?	career-2y	Open text	Qualitative coding (categories)
	Could you tell us briefly what happen to you that you decided to take another path besides Design?	why-dropout	Open text	Qualitative coding (categories)
Self-identification	*How much do you identify yourself as being a Designer?*	howmuch-designer	% scale	0% = I don't consider myself as being a designer 100% = I consider myself very hard

5.7.3 Measured psychometric survey items and relation to DPI meaning

Coding:	Observation:
1 – Strongly disagree **2 - Disagree** **3 - Agree** **4 – Strongly agree** **5 – I'm not sure**	• On the datasheet the questions with inverted relation to the concept were modified to address the defined meaning. • Answers coded as **5 – I don't know** were left out of the analysis.

Variable	Question/psychometric item	Relation to Concept
DS_CogAb_q1	It is hard to create a new concept by associating different ideas	-
DS_CogAb_q2	It is not easy to find the key elements in a problem/solution/design.	-
DS_CogAb_q3	It is difficult to judge the intentions behind a design	-
DS_CogStr_q1	I try to identify areas for improvement	+
DS_Cogstr_q2	I don't like to use a text-book method	-
DS_Cogstr_q3	I am not good at doing detailed research on the design	-
DS_PerCom_q1	People understand when I try to explain an idea	+
DS_PerCom_q2	I try to organize my ideas systematically	+
DS_PerCom_q3	Usually I am good with public speaking	+
DS_IntCom_q1	I don't use visual resources in my presentations	-
DS_IntCom_q2	I find it easy to create visualizations of a concept	+
DS_IntCom_q3	I think it's important to bond as a team	+

DS_Pract_q1	I like to think about the concept before start the designing process	+
DS_Pract_q2	I don't like to spend time creating unnecessary alternatives	-
DS_Pract_q3	I am not good at negotiating with the client	-
DS_Pract_q4	I am good at using the software needed for my job	+
DS_Pract_q5	I don't need anybody to help me to do my work	+
DS_Educat_q1	People can understand my reports even when they are not from my field	+
DS_Educat_q2	It is hard recognize and identify the main authors and methods in my field	-
DS_Educat_q3	I am not good with technology	-
DS_Manager_q1	It is hard to organize myself to accomplish all the tasks in a project	-
DS_Manager_q2	I don't like to manage my colleagues when it's not my role	-
DS_Manager_q3	I am not a good manager	+
DS_ProjMan_q1	I'm bad in evaluating the best and worst case scenario	-
DS_ProjMan_q2	I try to change my working environment in order to improve my effectiveness	+
DS_ProjMan_q3	I can't see the project fails until its done	-
PA_Emotion_q1	I think about the impact of my design to others	+
PA_Emotion_q1	I don't feel responsible for the product after deliver the project	-
PA_Emotion_q2	I feel responsible for my creations	+
PA_Openn_q1	I connect ideas from many sources	+
PA_Openn_q2	I know how to improvise	+
PA_Openn_q3	I look for better ways to do things	+
PA_SocAb_q1	I feel afraid of sharing my knowledge and people take my ideas	-
PA_SocialAb_q2	I am shy to present my ideas	-
PA_Lead_q1	I wait for others to lead the way	-
PA_Lead_q2	I prefer to have someone that orients me with my work	-
PA_Lead_q3	I prefer to move forward than be questioning decisions	-
PA_Ethic_q1	I am more capable than most others	-
PA_Ethic_q2	I am interested on the entire chain that supports my product development	+
PA_Ethic_q3	For me design is all about aesthetic expression	-
PA_Confid_q1	I don't like to be the center of attention	-
PA_Confid_q2	I concern about the quality of my work	-
PA_Confid_q3	Usually my colleagues are motivated by my attitudes	+
PA_Confid_q4	I don't like to work on risky projects	-

PA_Respon_q1	I pay too little attention to details	-
PA_Respon_q2	Usually the mistakes are not my fault	-
PA_Respon_q3	Accomplish the deadline is more important than the details to be correct	-

*Refined version from Second Round

PA_Confid_q2	-	I don't like to work on risky projects
PA_Confid_q3	+	Usually my colleagues are motivated by my attitudes
PA_Emotion_q2	+	I feel responsible for my creations
PA_Emotion_q3	+	I think about the impact of my design to others
PA_Ethic_q1	+	I am interested on the entire chain that supports my product development
PA_Ethic_q2	-	For me design is all about aesthetic expression
PA_Ethic_q3	-	I am more capable than most others
PA_LEAD_q2	-	I prefer to have someone that orients me with my work
PA_LEAD_q3	-	I wait for others to lead the way
PA_Openn_q1	+	I know how to improvise
PA_Openn_q2	+	I connect ideas from many sources
PA_Respon_q2	-	Accomplish the deadline is more important than the details to be correct
PA_Respon_q3	-	I pay too little attention to details
PA_SocialAb_1	-	I feel afraid of sharing my knowledge and people take my ideas
PA_SocialAb_2	-	I am shy to present my ideas

DS_CogAb_q1	-	It is hard to create a new concept by associating different ideas
DS_CogAb_q2	-	It is not easy to find the key elements in a problem/solution/design
DS_Cogstr_q1	+	I try to identify areas for improvement
DS_Cogstr_q2	-	I am not good at doing detailed research on the design
DS_Cogstr_q3	-	I don't like to use a text-book method
DS_Educat_q1	-	I am not good with technology
DS_Educat_q3	+	People can understand my reports even when they are not from my field
DS_IntCom_q2	+	I find it easy to create visualizations of a concept
DS_IntCom_q3	-	I don't use visual resources in my presentations
DS_Manager_q3	-	It is hard to organize myself to accomplish all the tasks in a project
DS_PerCom_q1	+	I try to organize my ideas systematically
DS_PerCom_q2	+	Usually I am good with public speaking
DS_PerCom_q3	+	People understand when I try to explain an idea
DS_Pract_q3	+	I like to think about the concept before start the designing process
DS_Pract_q5	+	My previous experiences help me to improve the quality of my work
DS_ProjMan_q3	+	I try to change my working environment in order to improve my effectiveness

5.7.4 Exploratory Analysis & Robustness checks: Statistical analysis of psychometric survey items

Comparison between Universities

	DTU						DELFT					
	edu-level=1			edu-level=2			edu-level=1			edu-level=2		
	Avg	St.D	Cat.	Avg	St.D	Cat.	Avg	St.D	Cat.	Avg	St.D	Cat.
PA_Confid_q1	2,74	1,06	2,71	2,73	1,04	2,73	2,68	0,94	2,70	2,74	0,98	2,74
PA_Confid_q2	1,55	0,81		1,66	0,76		1,72	0,65		1,76	0,70	
PA_Confid_q3	3,23	1,43		3,28	1,37		3,22	1,34		3,31	1,32	
PA_Confid_q4	3,33	0,87		3,25	0,86		3,16	0,89		3,16	0,86	
PA_Emotion_q1	4,28	0,82	4,09	4,19	0,78	4,00	4,00	0,72	3,84	4,10	0,71	3,92
PA_Emotion_q2	4,38	0,88		4,30	0,78		4,17	0,57		4,27	0,57	
PA_Emotion_q3	3,59	0,83		3,50	0,78		3,34	0,75		3,39	0,71	
PA_Ethic_q1	3,07	1,39	3,52	3,11	1,28	3,45	3,30	1,18	3,35	3,18	1,20	3,40
PA_Ethic_q2	4,09	0,99		3,98	0,96		3,78	0,93		3,87	0,93	
PA_Ethic_q3	3,39	0,86		3,25	0,86		2,96	0,83		3,14	0,85	
PA_Lead_q1	3,31	0,86	3,08	3,23	0,88	2,95	3,10	0,94	2,79	3,11	0,89	2,77
PA_Lead_q2	3,09	1,27		2,85	1,23		2,54	1,12		2,53	1,12	
PA_Lead_q3	2,85	1,16		2,76	1,11		2,75	0,97		2,65	1,02	
PA_Openn_q1	4,16	0,99	4,21	4,06	0,93	4,11	3,80	0,97	3,96	3,91	0,89	4,01
PA_Openn_q2	4,14	0,95		4,06	0,95		3,93	0,98		3,97	0,94	
PA_Openn_q3	4,34	0,81		4,22	0,78		4,15	0,64		4,14	0,73	
PA_Respon_q1	3,21	0,79	3,26	3,22	0,84	3,20	3,19	0,87	3,14	3,23	0,88	3,14
PA_Respon_q2	3,58	1,29		3,43	1,12		3,35	0,89		3,27	0,94	
PA_Respon_q3	2,98	1,14		2,94	1,04		2,89	0,87		2,91	0,93	
PA_SocAb_q1	3,38	0,80	3,26	3,28	0,82	3,13	3,17	0,79	2,97	3,14	0,81	2,99
PA_SocialAb_q2	3,14	0,72		2,98	0,82		2,76	0,81		2,84	0,87	
DS_CogAb_q1	3,34	0,88	3,19	3,19	0,90	3,05	3,01	0,88	2,86	3,05	0,88	2,92
DS_CogAb_q2	2,96	1,08		2,77	1,01		2,51	0,82		2,60	0,87	
DS_CogAb_q3	3,28	1,00		3,19	1,01		3,07	0,99		3,10	1,02	
DS_CogStr_q1	4,34	0,79	3,56	4,26	0,73	3,39	4,17	0,59	3,17	4,17	0,67	3,23
DS_Cogstr_q2	3,14	1,08		2,83	1,10		2,41	1,06		2,51	1,03	
DS_Cogstr_q3	3,22	0,93		3,08	0,95		2,92	0,97		3,00	0,97	
DS_PerCom_q1	3,80	1,05	3,82	3,69	1,06	3,68	3,62	1,02	3,46	3,66	0,98	3,57
DS_PerCom_q2	3,91	0,83		3,78	0,90		3,40	0,95		3,63	0,95	
DS_PerCom_q3	3,75	1,11		3,57	1,11		3,37	1,05		3,43	1,09	
DS_IntCom_q1	3,58	0,65	3,92	3,61	0,60	3,90	3,61	0,53	3,87	3,65	0,57	3,86
DS_IntCom_q2	3,83	1,00		3,69	0,98		3,58	1,08		3,55	0,99	
DS_IntCom_q3	4,37	0,83		4,39	0,78		4,41	0,63		4,40	0,75	
	DTU						DELFT					

	edu-level=1			edu-level=2			edu-level=1			edu-level=2		
	Avg	St.D	Cat.	Avg	St.D	Cat.	Avg	St.D	Cat.	Avg	St.D	Cat.
DS_Educat_q1	3,22	1,46	3,38	3,22	1,40	3,29	3,15	1,35	3,15	3,31	1,29	3,23
DS_Educat_q2	3,50	1,31		3,32	1,26		3,09	1,22		3,15	1,20	
DS_Educat_q3	3,42	0,82		3,32	0,84		3,21	0,90		3,24	0,86	
DS_Pract_q1	3,69	1,20	3,60	3,76	1,02	3,53	3,88	0,83	3,47	3,80	0,86	3,47
DS_Pract_q2	2,85	1,08		2,65	1,00		2,50	0,96		2,48	0,93	
DS_Pract_q3	3,37	1,13		3,39	1,12		3,50	1,14		3,41	1,10	
DS_Pract_q4	3,70	1,30		3,59	1,23		3,38	1,26		3,50	1,18	
DS_Pract_q5	4,38	0,78		4,26	0,81		4,09	0,83		4,17	0,83	
DS_Manager_q1	2,87	0,99	2,77	2,79	0,98	2,77	2,65	0,97	2,80	2,74	0,98	2,76
DS_Manager_q2	2,92	1,06		2,86	1,01		2,84	0,91		2,77	0,92	
DS_Manager_q3	2,51	1,02		2,65	1,02		2,90	1,13		2,76	1,03	
DS_ProjMan_q1	3,38	0,87	3,61	3,32	0,87	3,51	3,24	0,92	3,36	3,26	0,90	3,42
DS_ProjMan_q2	3,91	0,96		3,88	0,96		3,78	0,91		3,86	0,93	
DS_ProjMan_q3	3,52	1,00		3,33	0,94		3,07	0,80		3,14	0,87	

	DTU				**DELFT**					
	Edu-level=1		Edu-level=2		Edu-level=1		Edu-level=2		T-Test	
	Avg	St.D	Avg	St.D	Avg	St.D	Avg	St.D	Edu=1	Edu=2
Rank-CogAb	3,33	2,16	3,21	2,12	3,12	2,04	3,16	2,07	0,20	0,39
Rank-CogStr	3,74	2,22	3,73	2,22	3,68	2,25	3,75	2,24	0,42	0,46
Rank-PerComm	3,39	1,97	3,47	1,99	3,52	1,93	3,57	2,06	0,29	0,29
Rank-InterComm	4,93	2,16	4,90	2,14	4,95	2,13	4,76	2,12	0,46	0,24
Rank-EduKnowl	5,28	2,22	5,30	2,25	5,31	2,27	5,39	2,30	0,45	0,34
Rank-PractKnowl	4,88	2,29	5,13	2,25	4,81	2,31	5,33	2,25	0,41	0,16
Rank-ManComp	5,85	1,88	5,79	1,83	5,86	1,86	5,72	1,75	0,47	0,34
Rank-ProjMan	4,61	2,11	4,47	2,10	4,75	2,13	4,32	2,12	0,30	0,22

	T-TEST DTU & DELFT			
	edu=1		edu=2	
	Average	Category	Average	Category
PA_Confid_q1	0,32	0,23	0,44	0,27
PA_Confid_q2	0,04*		0,07	
PA_Confid_q3	0,49		0,42	
PA_Confid_q4	0,07		0,14	
PA_Emotion_q1	0,00*	0,01*	0,12	0,16
PA_Emotion_q2	0,01*		0,31	
PA_Emotion_q3	0,00*		0,06	

(cont. TTEST)	edu=1		edu=2	
	Average	Category	Average	Category
PA_Ethic_q1	0,08	0,03*	0,26	0,15
PA_Ethic_q2	0,00*		0,10	
PA_Ethic_q3	0,00*		0,08	
PA_Lead_q1	0,03*	0,08	0,07	0,07
PA_Lead_q2	0,00*		0,00*	
PA_Lead_q3	0,22		0,14	
PA_Openn_q1	0,00*	0,02*	0,05*	0,11
PA_Openn_q2	0,04*		0,16	
PA_Openn_q3	0,02*		0,11	
PA_Respon_q1	0,41	0,24	0,45	0,29
PA_Respon_q2	0,06		0,05	
PA_Respon_q3	0,24		0,38	
PA_SocAb_q1	0,01*	0,01*	0,03*	0,03*
PA_SocialAb_q2	0,00*		0,03*	
DS_CogAb_q1	0,00*	0,02*	0,05*	0,08
DS_CogAb_q2	0,00*		0,03*	
DS_CogAb_q3	0,04*		0,17	
DS_CogStr_q1	0,03*	0,01*	0,08	0,08
DS_Cogstr_q2	0,00*		0,00*	
DS_Cogstr_q3	0,01*		0,17	
DS_PerCom_q1	0,08	0,03*	0,35	0,16
DS_PerCom_q2	0,00*		0,04*	
DS_PerCom_q3	0,00*		0,09	
DS_IntCom_q1	0,35	0,23	0,24	0,25
DS_IntCom_q2	0,03*		0,05	
DS_IntCom_q3	0,32		0,47	
DS_Educat_q1	0,36	0,13	0,23	0,15
DS_Educat_q2	0,01*		0,06	
DS_Educat_q3	0,02*		0,16	
DS_Pract_q1	0,07	0,06*	0,30	0,22
DS_Pract_q2	0,00*		0,03*	
DS_Pract_q3	0,19		0,44	
DS_Pract_q4	0,02*		0,21	
DS_Pract_q5	0,00*		0,10	
DS_Manager_q1	0,04*	0,09*	0,29	0,18
DS_Manager_q2	0,23		0,16	
DS_Manager_q3	0,00*		0,11	
DS_ProjMan_q1	0,10	0,07*	0,23	0,21
DS_ProjMan_q2	0,12		0,38	
DS_ProjMan_q3	0,00*		0,01*	

Pairwise correlations

	DS_CogAb_q1	*DS_CogAb_q2*	*DS_CogAb_q3*
DS_CogAb_q1	1		
DS_CogAb_q2	0,2922	1	
DS_CogAb_q3	0,1587	0,0981	1

	DS_CogStr_q1	*DS_Cogstr_q2*	*DS_Cogstr_q3*
DS_CogStr_q1	1		
DS_Cogstr_q2	-0,148108639	1	
DS_Cogstr_q3	0,169296291	0,310301528	1

	DS_PerCom_q1	*DS_PerCom_q2*	*DS_PerCom_q3*
DS_PerCom_q1	1		
DS_PerCom_q2	0,130802946	1	
DS_PerCom_q3	0,234983819	0,038171842	1

	DS_IntCom_q1	*DS_IntCom_q2*	*DS_IntCom_q3*
DS_IntCom_q1	1		
DS_IntCom_q2	0,271509585	1	
DS_IntCom_q3	0,005045297	0,245255466	1

	DS_Pract_q1	*DS_Pract_q2*	*DS_Pract_q3*	*DS_Pract_q4*	*DS_Pract_q5*
DS_Pract_q1	1				
DS_Pract_q2	-0,141768527	1			
DS_Pract_q3	0,112920139	0,173641731	1		
DS_Pract_q4	0,000905378	-0,040469918	-0,036825687	1	
DS_Pract_q5	0,053625649	0,149450614	-0,0518251	0,050902015	1

	DS_Educat_q1	*DS_Educat_q2*	*DS_Educat_q3*
DS_Educat_q1	1		
DS_Educat_q2	-0,234306977	1	
DS_Educat_q3	-0,101638754	-0,054443886	1

	DS_Manager_q1	*DS_Manager_q2*	*DS_Manager_q3*
DS_Manager_q1	1		
DS_Manager_q2	0,082956444	1	
DS_Manager_q3	-0,272713029	-0,020863964	1

	DS_ProjMan_q1	*DS_ProjMan_q2*	*DS_ProjMan_q3*
DS_ProjMan_q1	1		
DS_ProjMan_q2	-0,259287612	1	
DS_ProjMan_q3	0,065746302	-0,096887366	1

	PA_Emotion_q1	*PA_Emotion_q1*	*PA_Emotion_q2*
PA_Emotion_q1	1		
PA_Emotion_q1	-0,103538112	1	
PA_Emotion_q2	0,408076879	0,303348113	1

	PA_Openn_q1	*PA_Openn_q2*	*PA_Openn_q3*
PA_Openn_q1	1		
PA_Openn_q2	0,213895938	1	
PA_Openn_q3	0,213004367	0,212876918	1

	PA_SocAb_q1	*PA_SocialAb_q2*
PA_SocAb_q1	1	
PA_SocialAb_q2	0,138936543	1

	PA_Lead_q1	*PA_Lead_q2*	*PA_Lead_q3*
PA_Lead_q1	1		
PA_Lead_q2	0,08269345	1	
PA_Lead_q3	-0,08245993	-0,089834367	1

	PA_Ethic_q1	*PA_Ethic_q2*	*PA_Ethic_q3*
PA_Ethic_q1	1		
PA_Ethic_q2	0,038336955	1	
PA_Ethic_q3	-0,101877678	-0,079460387	1

	PA_Confid_q1	*PA_Confid_q2*	*PA_Confid_q3*	*PA_Confid_q4*
PA_Confid_q1	1			
PA_Confid_q2	-0,057167638	1		
PA_Confid_q3	0,160431464	0,085813811	1	
PA_Confid_q4	0,041587476	-0,021658473	-0,0241306	1

	PA_Respon_q1	*PA_Respon_q2*	*PA_Respon_q3*
PA_Respon_q1	1		
PA_Respon_q2	-0,09233365	1	
PA_Respon_q3	0,167172953	0,030917329	1

a) ANOVA

*all items based on edu-level		Sum of Squares	df	Mean Square	F	Sig.
DS_PerCom_q1	Between Groups	10,556	3	3,519	3,210	,023
	Within Groups	371,554	339	1,096		
	Total	382,111	342			
PA_Lead_q1	Between Groups	1,465	3	,488	,620	,602
	Within Groups	281,112	357	,787		
	Total	282,576	360			
PA_Ethic_q1	Between Groups	9,763	3	3,254	2,001	,114
	Within Groups	525,344	323	1,626		
	Total	535,107	326			
PA_Openn_q1	Between Groups	4,716	3	1,572	1,763	,154
	Within Groups	302,257	339	,892		
	Total	306,974	342			
PA_Openn_q2	Between Groups	,696	3	,232	,250	,861
	Within Groups	330,761	357	,927		
	Total	331,457	360			
DS_Manager_q1	Between Groups	4,569	3	1,523	1,571	,196
	Within Groups	313,015	323	,969		
	Total	317,584	326			
DS_CogStr_q1	Between Groups	1,533	3	,511	,948	,417
	Within Groups	192,384	357	,539		
	Total	193,917	360			
DS_Manager_q2	Between Groups	3,995	3	1,332	1,341	,261
	Within Groups	354,626	357	,993		
	Total	358,620	360			
DS_Manager_q3	Between Groups	1,429	3	,476	,439	,725
	Within Groups	350,535	323	1,085		
	Total	351,963	326			
DS_CogAb_q1	Between Groups	5,248	3	1,749	2,197	,088
	Within Groups	283,408	356	,796		
	Total	288,656	359			
PA_Confid_q1	Between Groups	2,448	3	,816	,754	,521
	Within Groups	349,485	323	1,082		
	Total	351,933	326			
PA_SocAb_q1	Between Groups	14,244	3	4,748	7,299	,000
	Within Groups	232,227	357	,650		
	Total	246,471	360			
PA_Confid_q2	Between Groups	1,564	3	,521	,855	,465
	Within Groups	206,798	339	,610		
	Total	208,362	342			
PA_Emotion_q1	Between Groups	10,945	3	3,648	6,187	,000
	Within Groups	199,912	339	,590		
	Total	210,857	342			
PA_Respon_q1	Between Groups	,137	3	,046	,064	,979
	Within Groups	232,199	323	,719		
	Total	232,336	326			
DS_IntCom_q1	Between Groups	1,250	3	,417	1,130	,337
	Within Groups	119,068	323	,369		
	Total	120,318	326			

Rank-CogAb	Between Groups	33,697	3	11,232	2,483	,061
	Within Groups	1601,121	354	4,523		
	Total	1634,818	357			
Rank-CogStr	Between Groups	38,945	3	12,982	2,696	,046
	Within Groups	1704,678	354	4,815		
	Total	1743,623	357			
Rank-PerComm	Between Groups	1,171	3	,390	,095	,963
	Within Groups	1450,304	354	4,097		
	Total	1451,475	357			
Rank-InterComm	Between Groups	40,676	3	13,559	3,002	,031
	Within Groups	1599,092	354	4,517		
	Total	1639,768	357			
Rank-EduKnowl	Between Groups	11,024	3	3,675	,716	,543
	Within Groups	1817,233	354	5,133		
	Total	1828,257	357			
Rank-PractKnowl	Between Groups	78,611	3	26,204	5,344	,001
	Within Groups	1735,836	354	4,903		
	Total	1814,447	357			
Rank-ManComp	Between Groups	30,543	3	10,181	3,110	,026
	Within Groups	1158,798	354	3,273		
	Total	1189,341	357			
Rank-ProjMan	Between Groups	16,938	3	5,646	1,276	,283
	Within Groups	1566,953	354	4,426		
	Total	1583,891	357			
PA_Ethic_q2	Between Groups	5,279	3	1,760	1,943	,122
	Within Groups	306,148	338	,906		
	Total	311,427	341			
DS_PerCom_q2	Between Groups	7,997	3	2,666	3,356	,019
	Within Groups	283,566	357	,794		
	Total	291,562	360			
DS_Pract_q1	Between Groups	4,371	3	1,457	1,424	,236
	Within Groups	330,565	323	1,023		
	Total	334,936	326			
DS_Educat_q1	Between Groups	16,018	3	5,339	2,765	,042
	Within Groups	623,694	323	1,931		
	Total	639,713	326			
PA_Emotion_q1	Between Groups	1,222	3	,407	,646	,586
	Within Groups	224,994	357	,630		
	Total	226,216	360			
PA_Emotion_q2	Between Groups	6,123	3	2,041	3,381	,018
	Within Groups	215,489	357	,604		
	Total	221,612	360			
PA_SocialAb_q2	Between Groups	5,134	3	1,711	2,532	,057
	Within Groups	228,445	338	,676		
	Total	233,579	341			
DS_Pract_q2	Between Groups	8,275	3	2,758	2,843	,038
	Within Groups	313,419	323	,970		
	Total	321,694	326			
PA_Ethic_q3	Between Groups	15,760	3	5,253	7,437	,000
	Within Groups	228,154	323	,706		
	Total	243,914	326			
DS_ProjMan_q1	Between Groups	,442	3	,147	,192	,902

	Within Groups	259,983	339	,767		
	Total	260,426	342			
PA_Lead_q2	Between Groups	3,488	3	1,163	,741	,528
	Within Groups	560,307	357	1,569		
	Total	563,795	360			
DS_Cogstr_q2	Between Groups	8,191	3	2,730	2,233	,084
	Within Groups	394,873	323	1,223		
	Total	403,064	326			
DS_Cogstr_q3	Between Groups	4,928	3	1,643	1,813	,144
	Within Groups	306,244	338	,906		
	Total	311,173	341			
DS_IntCom_q2	Between Groups	,851	3	,284	,290	,833
	Within Groups	330,436	338	,978		
	Total	331,287	341			
PA_Respon_q2	Between Groups	,138	3	,046	,037	,991
	Within Groups	402,449	323	1,246		
	Total	402,587	326			
DS_CogAb_q2	Between Groups	5,943	3	1,981	1,993	,115
	Within Groups	335,932	338	,994		
	Total	341,874	341			
Do you have any experience leading groups?	Between Groups	7,433	3	2,478	4,760	,003
	Within Groups	171,269	329	,521		
	Total	178,703	332			
leading-where	Between Groups	10,782	3	3,594	,871	,457
	Within Groups	784,378	190	4,128		
	Total	795,160	193			
manager-dummy	Between Groups	1,232	3	,411	13,389	,000
	Within Groups	11,315	369	,031		
	Total	12,547	372			
leading-years-Other	Between Groups	5,244	3	1,748	3,102	,031
	Within Groups	45,650	81	,564		
	Total	50,894	84			
DS_CogAb_q3	Between Groups	1,874	3	,625	,605	,612
	Within Groups	328,188	318	1,032		
	Total	330,062	321			
DS_Educat_q2	Between Groups	,902	3	,301	,188	,904
	Within Groups	533,288	334	1,597		
	Total	534,189	337			
DS_Pract_q3	Between Groups	7,311	3	2,437	1,942	,123
	Within Groups	417,994	333	1,255		
	Total	425,306	336			
PA_Lead_q3	Between Groups	,512	3	,171	,140	,936
	Within Groups	429,735	352	1,221		
	Total	430,247	355			
PA_Confid_q3	Between Groups	5,201	3	1,734	,922	,430
	Within Groups	597,905	318	1,880		
	Total	603,106	321			
DS_PerCom_q3	Between Groups	3,002	3	1,001	,821	,483
	Within Groups	406,919	334	1,218		
	Total	409,920	337			
DS_ProjMan_q2	Between Groups	2,396	3	,799	,839	,474
	Within Groups	302,862	318	,952		

	Total	305,258	321			
DS_Pract_q4	Between Groups	35,083	3	11,694	8,166	,000
	Within Groups	478,348	334	1,432		
	Total	513,432	337			
PA_Respon_q3	Between Groups	1,944	3	,648	,586	,625
	Within Groups	351,609	318	1,106		
	Total	353,553	321			
PA_Openn_q3	Between Groups	,580	3	,193	,309	,819
	Within Groups	198,436	317	,626		
	Total	199,016	320			
DS_Educat_q3	Between Groups	8,899	3	2,966	4,302	,005
	Within Groups	242,719	352	,690		
	Total	251,618	355			
DS_IntCom_q3	Between Groups	1,188	3	,396	,627	,598
	Within Groups	222,374	352	,632		
	Total	223,562	355			
DS_Pract_q5	Between Groups	6,048	3	2,016	3,074	,028
	Within Groups	208,576	318	,656		
	Total	214,624	321			
DS_ProjMan_q3	Between Groups	1,652	3	,551	,618	,604
	Within Groups	297,006	333	,892		
	Total	298,659	336			
PA_Confid_q4	Between Groups	2,736	3	,912	1,192	,313
	Within Groups	243,388	318	,765		
	Total	246,124	321			

b) Multiple Comparisons – Tukey HSD

Dependent Variable			**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
						Lower Bound	Upper Bound
DS_PerCom_q1	1.00	2.00	,23929	,12084	,197	-,0727	,5513
		3.00	-,36282	,23228	,402	-,9625	,2369
		4.00	-,27586	,29084	,779	-1,0268	,4750
	2.00	1.00	-,23929	,12084	,197	-,5513	,0727
		3.00	-,60211	,23655	,055	-1,2128	,0086
		4.00	-,51515	,29426	,299	-1,2749	,2446
	3.00	1.00	,36282	,23228	,402	-,2369	,9625
		2.00	,60211	,23655	,055	-,0086	1,2128
		4.00	,08696	,35488	,995	-,8293	1,0032
	4.00	1.00	,27586	,29084	,779	-,4750	1,0268
		2.00	,51515	,29426	,299	-,2446	1,2749
		3.00	-,08696	,35488	,995	-1,0032	,8293
PA_Lead_q1	1.00	2.00	-,09230	,10061	,796	-,3520	,1674
		3.00	-,09808	,17756	,946	-,5564	,3602
		4.00	,17778	,23847	,879	-,4378	,7933
	2.00	1.00	,09230	,10061	,796	-,1674	,3520
		3.00	-,00579	,18138	1,000	-,4740	,4624
		4.00	,27007	,24134	,678	-,3529	,8930
	3.00	1.00	,09808	,17756	,946	-,3602	,5564
		2.00	,00579	,18138	1,000	-,4624	,4740

		4.00	,27586	,28222	,762	-,4526	1,0043
	4.00	1.00	-,17778	,23847	,879	-,7933	,4378
		2.00	-,27007	,24134	,678	-,8930	,3529
		3.00	-,27586	,28222	,762	-1,0043	,4526
PA_Ethic_q1	1.00	2.00	,22036	,15045	,460	-,1682	,6089
		3.00	,44217	,28906	,421	-,3043	1,1886
		4.00	,71490	,39684	,274	-,3099	1,7397
	2.00	1.00	-,22036	,15045	,460	-,6089	,1682
		3.00	,22182	,29486	,876	-,5396	,9833
		4.00	,49455	,40109	,606	-,5412	1,5303
	3.00	1.00	-,44217	,28906	,421	-1,1886	,3043
		2.00	-,22182	,29486	,876	-,9833	,5396
		4.00	,27273	,47094	,938	-,9435	1,4889
	4.00	1.00	-,71490	,39684	,274	-1,7397	,3099
		2.00	-,49455	,40109	,606	-1,5303	,5412
		3.00	-,27273	,47094	,938	-1,4889	,9435
PA_Openn_q1	1.00	2.00	-,21108	,10899	,215	-,4925	,0703
		3.00	-,16167	,20950	,867	-,7026	,3792
		4.00	,21100	,26232	,852	-,4663	,8883
	2.00	1.00	,21108	,10899	,215	-,0703	,4925
		3.00	,04941	,21336	,996	-,5014	,6003
		4.00	,42208	,26541	,386	-,2632	1,1073
	3.00	1.00	,16167	,20950	,867	-,3792	,7026
		2.00	-,04941	,21336	,996	-,6003	,5014
		4.00	,37267	,32008	,650	-,4537	1,1991
	4.00	1.00	-,21100	,26232	,852	-,8883	,4663
		2.00	-,42208	,26541	,386	-1,1073	,2632
		3.00	-,37267	,32008	,650	-1,1991	,4537
PA_Openn_q2	1.00	2.00	-,08933	,10913	,846	-,3710	,1924
		3.00	,00556	,19260	1,000	-,4916	,5027
		4.00	,00556	,25868	1,000	-,6621	,6732
	2.00	1.00	,08933	,10913	,846	-,1924	,3710
		3.00	,09489	,19675	,963	-,4130	,6027
		4.00	,09489	,26178	,984	-,5808	,7706
	3.00	1.00	-,00556	,19260	1,000	-,5027	,4916
		2.00	-,09489	,19675	,963	-,6027	,4130
		4.00	0,00000	,30613	1,000	-,7902	,7902
	4.00	1.00	-,00556	,25868	1,000	-,6732	,6621
		2.00	-,09489	,26178	,984	-,7706	,5808
		3.00	0,00000	,30613	1,000	-,7902	,7902
DS_Manager_q1	1.00	2.00	-,10594	,11613	,798	-,4058	,1940
		3.00	-,47176	,22312	,151	-1,0480	,1044
		4.00	-,01721	,30632	1,000	-,8083	,7738
	2.00	1.00	,10594	,11613	,798	-,1940	,4058
		3.00	-,36582	,22760	,376	-,9536	,2220
		4.00	,08873	,30960	,992	-,7108	,8883
	3.00	1.00	,47176	,22312	,151	-,1044	1,0480
		2.00	,36582	,22760	,376	-,2220	,9536
		4.00	,45455	,36352	,595	-,4842	1,3933
	4.00	1.00	,01721	,30632	1,000	-,7738	,8083
		2.00	-,08873	,30960	,992	-,8883	,7108
		3.00	-,45455	,36352	,595	-1,3933	,4842

DS_CogStr_q1	1.00	2.00	,04530	,08323	,948	-,1695	,2601
		3.00	-,11705	,14689	,856	-,4962	,2621
		4.00	-,23889	,19728	,620	-,7481	,2703
	2.00	1.00	-,04530	,08323	,948	-,2601	,1695
		3.00	-,16235	,15005	,701	-,5497	,2250
		4.00	-,28418	,19965	,486	-,7995	,2311
	3.00	1.00	,11705	,14689	,856	-,2621	,4962
		2.00	,16235	,15005	,701	-,2250	,5497
		4.00	-,12184	,23347	,954	-,7245	,4808
	4.00	1.00	,23889	,19728	,620	-,2703	,7481
		2.00	,28418	,19965	,486	-,2311	,7995
		3.00	,12184	,23347	,954	-,4808	,7245
DS_Manager_q2	1.00	2.00	,08423	,11300	,879	-,2075	,3759
		3.00	-,07107	,19943	,984	-,5858	,4437
		4.00	,49444	,26785	,254	-,1969	1,1858
	2.00	1.00	-,08423	,11300	,879	-,3759	,2075
		3.00	-,15530	,20373	,871	-,6811	,3706
		4.00	,41022	,27106	,431	-,2894	1,1099
	3.00	1.00	,07107	,19943	,984	-,4437	,5858
		2.00	,15530	,20373	,871	-,3706	,6811
		4.00	,56552	,31698	,283	-,2527	1,3837
	4.00	1.00	-,49444	,26785	,254	-1,1858	,1969
		2.00	-,41022	,27106	,431	-1,1099	,2894
		3.00	-,56552	,31698	,283	-1,3837	,2527
DS_Manager_q3	1.00	2.00	,06864	,12290	,944	-,2487	,3860
		3.00	,21409	,23612	,801	-,3957	,8239
		4.00	-,14954	,32416	,967	-,9867	,6876
	2.00	1.00	-,06864	,12290	,944	-,3860	,2487
		3.00	,14545	,24086	,931	-,4765	,7675
		4.00	-,21818	,32763	,910	-1,0643	,6279
	3.00	1.00	-,21409	,23612	,801	-,8239	,3957
		2.00	-,14545	,24086	,931	-,7675	,4765
		4.00	-,36364	,38469	,780	-1,3571	,6298
	4.00	1.00	,14954	,32416	,967	-,6876	,9867
		2.00	,21818	,32763	,910	-,6279	1,0643
		3.00	,36364	,38469	,780	-,6298	1,3571
DS_CogAb_q1	1.00	2.00	-,06732	,10137	,911	-,3290	,1943
		3.00	-,45728	,17853	,053	-,9181	,0036
		4.00	-,10556	,23978	,971	-,7245	,5134
	2.00	1.00	,06732	,10137	,911	-,1943	,3290
		3.00	-,38996	,18250	,144	-,8610	,0811
		4.00	-,03824	,24275	,999	-,6648	,5883
	3.00	1.00	,45728	,17853	,053	-,0036	,9181
		2.00	,38996	,18250	,144	-,0811	,8610
		4.00	,35172	,28377	,602	-,3807	1,0842
	4.00	1.00	,10556	,23978	,971	-,5134	,7245
		2.00	,03824	,24275	,999	-,5883	,6648
		3.00	-,35172	,28377	,602	-1,0842	,3807
PA_Confid_q1	1.00	2.00	-,14736	,12271	,627	-,4643	,1695
		3.00	-,14954	,23576	,921	-,7584	,4593
		4.00	-,33136	,32368	,736	-1,1672	,5045
	2.00	1.00	,14736	,12271	,627	-,1695	,4643

		3.00	-,00218	,24049	1,000	-,6232	,6189
		4.00	-,18400	,32714	,943	-1,0288	,6608
	3.00	1.00	,14954	,23576	,921	-,4593	,7584
		2.00	,00218	,24049	1,000	-,6189	,6232
		4.00	-,18182	,38412	,965	-1,1738	,8101
	4.00	1.00	,33136	,32368	,736	-,5045	1,1672
		2.00	,18400	,32714	,943	-,6608	1,0288
		3.00	,18182	,38412	,965	-,8101	1,1738
PA_SocAb_q1	1.00	2.00	-,13118	,09144	,479	-,3672	,1048
		3.00	-.65421*	,16138	,000	-1,0708	-,2377
		4.00	-.59444*	,21675	,032	-1,1539	-,0350
	2.00	1.00	,13118	,09144	,479	-,1048	,3672
		3.00	-.52303*	,16486	,009	-,9486	-,0975
		4.00	-,46326	,21935	,151	-1,0294	,1029
	3.00	1.00	.65421*	,16138	,000	,2377	1,0708
		2.00	.52303*	,16486	,009	,0975	,9486
		4.00	,05977	,25651	,996	-,6023	,7219
	4.00	1.00	.59444*	,21675	,032	,0350	1,1539
		2.00	,46326	,21935	,151	-,1029	1,0294
		3.00	-,05977	,25651	,996	-,7219	,6023
PA_Confid_q2	1.00	2.00	-,08568	,09015	,778	-,3184	,1471
		3.00	-,19965	,17329	,657	-,6470	,2477
		4.00	-,23071	,21698	,712	-,7909	,3295
	2.00	1.00	,08568	,09015	,778	-,1471	,3184
		3.00	-,11397	,17648	,917	-,5696	,3417
		4.00	-,14502	,21953	,912	-,7118	,4218
	3.00	1.00	,19965	,17329	,657	-,2477	,6470
		2.00	,11397	,17648	,917	-,3417	,5696
		4.00	-,03106	,26476	,999	-,7146	,6525
	4.00	1.00	,23071	,21698	,712	-,3295	,7909
		2.00	,14502	,21953	,912	-,4218	,7118
		3.00	,03106	,26476	,999	-,6525	,7146
PA_Emotion_q1	1.00	2.00	-,03030	,08864	,986	-,2591	,1985
		3.00	-,26812	,17038	,395	-,7080	,1718
		4.00	.80952*	,21333	,001	,2587	1,3603
	2.00	1.00	,03030	,08864	,986	-,1985	,2591
		3.00	-,23781	,17351	,519	-,6858	,2102
		4.00	.83983*	,21585	,001	,2826	1,3971
	3.00	1.00	,26812	,17038	,395	-,1718	,7080
		2.00	,23781	,17351	,519	-,2102	,6858
		4.00	1.07764*	,26031	,000	,4056	1,7497
	4.00	1.00	-.80952*	,21333	,001	-1,3603	-,2587
		2.00	-.83983*	,21585	,001	-1,3971	-,2826
		3.00	-1.07764*	,26031	,000	-1,7497	-,4056
PA_Respon_q1	1.00	2.00	,02452	,10002	,995	-,2338	,2828
		3.00	,06670	,19217	,986	-,4296	,5630
		4.00	,06670	,26383	,994	-,6146	,7480
	2.00	1.00	-,02452	,10002	,995	-,2828	,2338
		3.00	,04218	,19603	,996	-,4641	,5484
		4.00	,04218	,26665	,999	-,6464	,7308
	3.00	1.00	-,06670	,19217	,986	-,5630	,4296
		2.00	-,04218	,19603	,996	-,5484	,4641

		4.00	0,00000	,31310	1,000	-,8086	,8086
	4.00	1.00	-,06670	,26383	,994	-,7480	,6146
		2.00	-,04218	,26665	,999	-,7308	,6464
		3.00	0,00000	,31310	1,000	-,8086	,8086
DS_IntCom_q1	1.00	2.00	-,00062	,07163	1,000	-,1856	,1844
		3.00	,02448	,13761	,998	-,3309	,3799
		4.00	,34266	,18893	,269	-,1452	,8306
	2.00	1.00	,00062	,07163	1,000	-,1844	,1856
		3.00	,02509	,14037	,998	-,3374	,3876
		4.00	,34327	,19095	,276	-,1498	,8364
	3.00	1.00	-,02448	,13761	,998	-,3799	,3309
		2.00	-,02509	,14037	,998	-,3876	,3374
		4.00	,31818	,22421	,488	-,2608	,8972
	4.00	1.00	-,34266	,18893	,269	-,8306	,1452
		2.00	-,34327	,19095	,276	-,8364	,1498
		3.00	-,31818	,22421	,488	-,8972	,2608
Rank-CogAb	1.00	2.00	,61227	,24265	,058	-,0141	1,2386
		3.00	-,13065	,42555	,990	-1,2291	,9678
		4.00	-,01111	,57154	1,000	-1,4864	1,4642
	2.00	1.00	-,61227	,24265	,058	-1,2386	,0141
		3.00	-,74292	,43556	,322	-1,8672	,3814
		4.00	-,62338	,57904	,704	-2,1180	,8713
	3.00	1.00	,13065	,42555	,990	-,9678	1,2291
		2.00	,74292	,43556	,322	-,3814	1,8672
		4.00	,11954	,67638	,998	-1,6264	1,8655
	4.00	1.00	,01111	,57154	1,000	-1,4642	1,4864
		2.00	,62338	,57904	,704	-,8713	2,1180
		3.00	-,11954	,67638	,998	-1,8655	1,6264
Rank-CogStr	1.00	2.00	,44444	,25038	,287	-,2018	1,0907
		3.00	-,05556	,43909	,999	-1,1890	1,0779
		4.00	1,41111	,58973	,080	-,1112	2,9334
	2.00	1.00	-,44444	,25038	,287	-1,0907	,2018
		3.00	-,50000	,44943	,682	-1,6601	,6601
		4.00	,96667	,59747	,370	-,5756	2,5089
	3.00	1.00	,05556	,43909	,999	-1,0779	1,1890
		2.00	,50000	,44943	,682	-,6601	1,6601
		4.00	1,46667	,69791	,155	-,3348	3,2682
	4.00	1.00	-1,41111	,58973	,080	-2,9334	,1112
		2.00	-,96667	,59747	,370	-2,5089	,5756
		3.00	-1,46667	,69791	,155	-3,2682	,3348
Rank-PerComm	1.00	2.00	-,05381	,23094	,996	-,6499	,5423
		3.00	,01284	,40501	1,000	-1,0326	1,0583
		4.00	-,27222	,54396	,959	-1,6763	1,1319
	2.00	1.00	,05381	,23094	,996	-,5423	,6499
		3.00	,06665	,41454	,999	-1,0034	1,1367
		4.00	-,21841	,55109	,979	-1,6409	1,2041
	3.00	1.00	-,01284	,40501	1,000	-1,0583	1,0326
		2.00	-,06665	,41454	,999	-1,1367	1,0034
		4.00	-,28506	,64374	,971	-1,9467	1,3766
	4.00	1.00	,27222	,54396	,959	-1,1319	1,6763
		2.00	,21841	,55109	,979	-1,2041	1,6409
		3.00	,28506	,64374	,971	-1,3766	1,9467

Rank-InterComm	1.00	2.00	,26924	,24250	,683	-,3567	,8952
		3.00	,96533	,42528	,107	-,1324	2,0631
		4.00	1,23889	,57118	,134	-,2355	2,7133
	2.00	1.00	-,26924	,24250	,683	-,8952	,3567
		3.00	,69609	,43529	,380	-,4275	1,8197
		4.00	,96965	,57867	,338	-,5241	2,4634
	3.00	1.00	-,96533	,42528	,107	-2,0631	,1324
		2.00	-,69609	,43529	,380	-1,8197	,4275
		4.00	,27356	,67595	,978	-1,4713	2,0184
	4.00	1.00	-1,23889	,57118	,134	-2,7133	,2355
		2.00	-,96965	,57867	,338	-2,4634	,5241
		3.00	-,27356	,67595	,978	-2,0184	1,4713
Rank-EduKnowl	1.00	2.00	-,11915	,25851	,967	-,7864	,5481
		3.00	,28563	,45336	,922	-,8846	1,4559
		4.00	-,71667	,60889	,642	-2,2884	,8550
	2.00	1.00	,11915	,25851	,967	-,5481	,7864
		3.00	,40479	,46403	,819	-,7930	1,6026
		4.00	-,59751	,61688	,767	-2,1898	,9948
	3.00	1.00	-,28563	,45336	,922	-1,4559	,8846
		2.00	-,40479	,46403	,819	-1,6026	,7930
		4.00	-1,00230	,72059	,506	-2,8623	,8577
	4.00	1.00	,71667	,60889	,642	-,8550	2,2884
		2.00	,59751	,61688	,767	-,9948	2,1898
		3.00	1,00230	,72059	,506	-,8577	2,8623
Rank-PractKnowl	1.00	2.00	-.92405*	,25266	,002	-1,5762	-,2719
		3.00	,16705	,44309	,982	-,9767	1,3108
		4.00	,22222	,59510	,982	-1,3139	1,7583
	2.00	1.00	.92405*	,25266	,002	,2719	1,5762
		3.00	1,09110	,45352	,078	-,0796	2,2618
		4.00	1,14627	,60290	,229	-,4100	2,7025
	3.00	1.00	-,16705	,44309	,982	-1,3108	,9767
		2.00	-1,09110	,45352	,078	-2,2618	,0796
		4.00	,05517	,70426	1,000	-1,7627	1,8731
	4.00	1.00	-,22222	,59510	,982	-1,7583	1,3139
		2.00	-1,14627	,60290	,229	-2,7025	,4100
		3.00	-,05517	,70426	1,000	-1,8731	1,7627
Rank-ManComp	1.00	2.00	-,32488	,20643	,395	-,8577	,2080
		3.00	-,67356	,36203	,247	-1,6081	,2609
		4.00	-1,20000	,48623	,067	-2,4551	,0551
	2.00	1.00	,32488	,20643	,395	-,2080	,8577
		3.00	-,34869	,37055	,783	-1,3052	,6078
		4.00	-,87512	,49260	,286	-2,1467	,3964
	3.00	1.00	,67356	,36203	,247	-,2609	1,6081
		2.00	,34869	,37055	,783	-,6078	1,3052
		4.00	-,52644	,57542	,797	-2,0118	,9589
	4.00	1.00	1,20000	,48623	,067	-,0551	2,4551
		2.00	,87512	,49260	,286	-,3964	2,1467
		3.00	,52644	,57542	,797	-,9589	2,0118
Rank-ProjMan	1.00	2.00	,09594	,24005	,978	-,5237	,7156
		3.00	-,57107	,42098	,528	-1,6577	,5156
		4.00	-,67222	,56541	,634	-2,1317	,7873
	2.00	1.00	-,09594	,24005	,978	-,7156	,5237

		3.00	-,66701	,43089	,410	-1,7793	,4452
		4.00	-,76816	,57282	,537	-2,2468	,7105
	3.00	1.00	,57107	,42098	,528	-,5156	1,6577
		2.00	,66701	,43089	,410	-,4452	1,7793
		4.00	-,10115	,66913	,999	-1,8283	1,6260
	4.00	1.00	,67222	,56541	,634	-,7873	2,1317
		2.00	,76816	,57282	,537	-,7105	2,2468
		3.00	,10115	,66913	,999	-1,6260	1,8283
PA_Ethic_q2	1.00	2.00	-,15895	,11009	,473	-,4432	,1253
		3.00	-,36107	,21116	,320	-,9062	,1841
		4.00	-,42939	,26439	,366	-1,1120	,2532
	2.00	1.00	,15895	,11009	,473	-,1253	,4432
		3.00	-,20212	,21516	,784	-,7576	,3534
		4.00	-,27045	,26760	,743	-,9614	,4205
	3.00	1.00	,36107	,21116	,320	-,1841	,9062
		2.00	,20212	,21516	,784	-,3534	,7576
		4.00	-,06832	,32261	,997	-,9013	,7646
	4.00	1.00	,42939	,26439	,366	-,2532	1,1120
		2.00	,27045	,26760	,743	-,4205	,9614
		3.00	,06832	,32261	,997	-,7646	,9013
DS_PerCom_q2	1.00	2.00	-.31764*	,10105	,010	-,5785	-,0568
		3.00	-,07299	,17833	,977	-,5333	,3873
		4.00	-,18333	,23951	,870	-,8016	,4349
	2.00	1.00	.31764*	,10105	,010	,0568	,5785
		3.00	,24465	,18217	,536	-,2256	,7149
		4.00	,13431	,24239	,945	-,4913	,7599
	3.00	1.00	,07299	,17833	,977	-,3873	,5333
		2.00	-,24465	,18217	,536	-,7149	,2256
		4.00	-,11034	,28345	,980	-,8420	,6213
	4.00	1.00	,18333	,23951	,870	-,4349	,8016
		2.00	-,13431	,24239	,945	-,7599	,4913
		3.00	,11034	,28345	,980	-,6213	,8420
DS_Pract_q1	1.00	2.00	,23815	,11934	,192	-,0700	,5464
		3.00	,07343	,22929	,989	-,5187	,6656
		4.00	-,06294	,31479	,997	-,8759	,7500
	2.00	1.00	-,23815	,11934	,192	-,5464	,0700
		3.00	-,16473	,23389	,895	-,7687	,4393
		4.00	-,30109	,31816	,780	-1,1227	,5205
	3.00	1.00	-,07343	,22929	,989	-,6656	,5187
		2.00	,16473	,23389	,895	-,4393	,7687
		4.00	-,13636	,37357	,983	-1,1011	,8284
	4.00	1.00	,06294	,31479	,997	-,7500	,8759
		2.00	,30109	,31816	,780	-,5205	1,1227
		3.00	,13636	,37357	,983	-,8284	1,1011
DS_Educat_q1	1.00	2.00	-,27408	,16393	,340	-,6974	,1493
		3.00	-,49408	,31495	,398	-1,3074	,3193
		4.00	-,99408	,43240	,100	-2,1107	,1226
	2.00	1.00	,27408	,16393	,340	-,1493	,6974
		3.00	-,22000	,32127	,903	-1,0497	,6097
		4.00	-,72000	,43702	,354	-1,8486	,4086
	3.00	1.00	,49408	,31495	,398	-,3193	1,3074
		2.00	,22000	,32127	,903	-,6097	1,0497

		4.00	-,50000	,51314	,764	-1,8252	,8252
	4.00	1.00	,99408	,43240	,100	-,1226	2,1107
		2.00	,72000	,43702	,354	-,4086	1,8486
		3.00	,50000	,51314	,764	-,8252	1,8252
PA_Emotion_q1	1.00	2.00	-,08666	,09001	,771	-,3190	,1457
		3.00	-,11284	,15885	,893	-,5229	,2972
		4.00	-,22778	,21335	,709	-,7785	,3229
	2.00	1.00	,08666	,09001	,771	-,1457	,3190
		3.00	-,02618	,16227	,999	-,4450	,3927
		4.00	-,14112	,21591	,914	-,6984	,4162
	3.00	1.00	,11284	,15885	,893	-,2972	,5229
		2.00	,02618	,16227	,999	-,3927	,4450
		4.00	-,11494	,25248	,969	-,7666	,5368
	4.00	1.00	,22778	,21335	,709	-,3229	,7785
		2.00	,14112	,21591	,914	-,4162	,6984
		3.00	,11494	,25248	,969	-,5368	,7666
PA_Emotion_q2	1.00	2.00	-,04132	,08809	,966	-,2687	,1860
		3.00	-,01590	,15546	1,000	-,4172	,3854
		4.00	.62778*	,20879	,015	,0888	1,1667
	2.00	1.00	,04132	,08809	,966	-,1860	,2687
		3.00	,02542	,15881	,999	-,3845	,4353
		4.00	.66910*	,21130	,009	,1237	1,2145
	3.00	1.00	,01590	,15546	1,000	-,3854	,4172
		2.00	-,02542	,15881	,999	-,4353	,3845
		4.00	.64368*	,24709	,047	,0059	1,2815
	4.00	1.00	-.62778*	,20879	,015	-1,1667	-,0888
		2.00	-.66910*	,21130	,009	-1,2145	-,1237
		3.00	-.64368*	,24709	,047	-1,2815	-,0059
PA_SocialAb_q2	1.00	2.00	-,12644	,09510	,545	-,3720	,1191
		3.00	-,43078	,18240	,087	-,9017	,0401
		4.00	-,34072	,22839	,444	-,9304	,2489
	2.00	1.00	,12644	,09510	,545	-,1191	,3720
		3.00	-,30435	,18586	,359	-,7842	,1755
		4.00	-,21429	,23116	,790	-,8111	,3825
	3.00	1.00	,43078	,18240	,087	-,0401	,9017
		2.00	,30435	,18586	,359	-,1755	,7842
		4.00	,09006	,27868	,988	-,6294	,8096
	4.00	1.00	,34072	,22839	,444	-,2489	,9304
		2.00	,21429	,23116	,790	-,3825	,8111
		3.00	-,09006	,27868	,988	-,8096	,6294
DS_Pract_q2	1.00	2.00	-,00828	,11621	1,000	-,3084	,2918
		3.00	-,18101	,22327	,849	-,7576	,3956
		4.00	-.86283*	,30652	,026	-1,6544	-,0713
	2.00	1.00	,00828	,11621	1,000	-,2918	,3084
		3.00	-,17273	,22775	,873	-,7609	,4154
		4.00	-.85455*	,30980	,031	-1,6546	-,0545
	3.00	1.00	,18101	,22327	,849	-,3956	,7576
		2.00	,17273	,22775	,873	-,4154	,7609
		4.00	-,68182	,36376	,241	-1,6212	,2576
	4.00	1.00	.86283*	,30652	,026	,0713	1,6544
		2.00	.85455*	,30980	,031	,0545	1,6546
		3.00	,68182	,36376	,241	-,2576	1,6212

PA_Ethic_q3	1.00	2.00	-.25699*	,09915	,049	-,5130	-,0009
		3.00	-.74718*	,19049	,001	-1,2391	-,2552
		4.00	-,65627	,26152	,060	-1,3316	,0191
	2.00	1.00	.25699*	,09915	,049	,0009	,5130
		3.00	-,49018	,19431	,058	-,9920	,0116
		4.00	-,39927	,26432	,432	-1,0819	,2833
	3.00	1.00	.74718*	,19049	,001	,2552	1,2391
		2.00	,49018	,19431	,058	-,0116	,9920
		4.00	,09091	,31036	,991	-,7106	,8924
	4.00	1.00	,65627	,26152	,060	-,0191	1,3316
		2.00	,39927	,26432	,432	-,2833	1,0819
		3.00	-,09091	,31036	,991	-,8924	,7106
DS_ProjMan_q1	1.00	2.00	,02612	,10108	,994	-,2349	,2871
		3.00	,08146	,19430	,975	-,4202	,5831
		4.00	-,12972	,24328	,951	-,7578	,4984
	2.00	1.00	-,02612	,10108	,994	-,2871	,2349
		3.00	,05534	,19787	,992	-,4555	,5662
		4.00	-,15584	,24615	,921	-,7914	,4797
	3.00	1.00	-,08146	,19430	,975	-,5831	,4202
		2.00	-,05534	,19787	,992	-,5662	,4555
		4.00	-,21118	,29686	,893	-,9776	,5552
	4.00	1.00	,12972	,24328	,951	-,4984	,7578
		2.00	,15584	,24615	,921	-,4797	,7914
		3.00	,21118	,29686	,893	-,5552	,9776
PA_Lead_q2	1.00	2.00	-,02830	,14204	,997	-,3949	,3383
		3.00	-,25785	,25068	,733	-,9049	,3892
		4.00	-,38889	,33668	,656	-1,2579	,4801
	2.00	1.00	,02830	,14204	,997	-,3383	,3949
		3.00	-,22955	,25608	,807	-,8905	,4314
		4.00	-,36058	,34072	,715	-1,2400	,5189
	3.00	1.00	,25785	,25068	,733	-,3892	,9049
		2.00	,22955	,25608	,807	-,4314	,8905
		4.00	-,13103	,39844	,988	-1,1595	,8974
	4.00	1.00	,38889	,33668	,656	-,4801	1,2579
		2.00	,36058	,34072	,715	-,5189	1,2400
		3.00	,13103	,39844	,988	-,8974	1,1595
DS_Cogstr_q2	1.00	2.00	-,14802	,13044	,668	-,4849	,1888
		3.00	-,46584	,25060	,248	-1,1130	,1813
		4.00	-,64766	,34405	,238	-1,5362	,2408
	2.00	1.00	,14802	,13044	,668	-,1888	,4849
		3.00	-,31782	,25563	,600	-,9780	,3423
		4.00	-,49964	,34773	,477	-1,3976	,3984
	3.00	1.00	,46584	,25060	,248	-,1813	1,1130
		2.00	,31782	,25563	,600	-,3423	,9780
		4.00	-,18182	,40830	,970	-1,2362	,8726
	4.00	1.00	,64766	,34405	,238	-,2408	1,5362
		2.00	,49964	,34773	,477	-,3984	1,3976
		3.00	,18182	,40830	,970	-,8726	1,2362
DS_Cogstr_q3	1.00	2.00	-,04185	,11011	,981	-,3261	,2424
		3.00	,03448	,21119	,998	-,5108	,5797
		4.00	-,60837	,26443	,100	-1,2911	,0744
	2.00	1.00	,04185	,11011	,981	-,2424	,3261

		3.00	,07634	,21520	,985	-,4793	,6319
		4.00	-,56652	,26765	,150	-1,2575	,1245
	3.00	1.00	-,03448	,21119	,998	-,5797	,5108
		2.00	-,07634	,21520	,985	-,6319	,4793
		4.00	-,64286	,32266	,193	-1,4759	,1902
	4.00	1.00	,60837	,26443	,100	-,0744	1,2911
		2.00	,56652	,26765	,150	-,1245	1,2575
		3.00	,64286	,32266	,193	-,1902	1,4759
DS_IntCom_q2	1.00	2.00	,02347	,11437	,997	-,2718	,3188
		3.00	-,08971	,21937	,977	-,6561	,4767
		4.00	-,20772	,27468	,874	-,9169	,5015
	2.00	1.00	-,02347	,11437	,997	-,3188	,2718
		3.00	-,11318	,22354	,958	-,6903	,4640
		4.00	-,23119	,27802	,839	-,9490	,4866
	3.00	1.00	,08971	,21937	,977	-,4767	,6561
		2.00	,11318	,22354	,958	-,4640	,6903
		4.00	-,11801	,33516	,985	-,9834	,7473
	4.00	1.00	,20772	,27468	,874	-,5015	,9169
		2.00	,23119	,27802	,839	-,4866	,9490
		3.00	,11801	,33516	,985	-,7473	,9834
PA_Respon_q2	1.00	2.00	-,00805	,13168	1,000	-,3481	,3320
		3.00	-,02259	,25300	1,000	-,6759	,6308
		4.00	-,11350	,34734	,988	-1,0105	,7835
	2.00	1.00	,00805	,13168	1,000	-,3320	,3481
		3.00	-,01455	,25808	1,000	-,6810	,6519
		4.00	-,10545	,35105	,991	-1,0120	,8011
	3.00	1.00	,02259	,25300	1,000	-,6308	,6759
		2.00	,01455	,25808	1,000	-,6519	,6810
		4.00	-,09091	,41220	,996	-1,1554	,9736
	4.00	1.00	,11350	,34734	,988	-,7835	1,0105
		2.00	,10545	,35105	,991	-,8011	1,0120
		3.00	,09091	,41220	,996	-,9736	1,1554
DS_CogAb_q2	1.00	2.00	-,11771	,11532	,737	-,4154	,1800
		3.00	-,33908	,22119	,419	-,9102	,2320
		4.00	-,55337	,27695	,191	-1,2684	,1617
	2.00	1.00	,11771	,11532	,737	-,1800	,4154
		3.00	-,22137	,22539	,760	-,8033	,3605
		4.00	-,43566	,28032	,406	-1,1594	,2881
	3.00	1.00	,33908	,22119	,419	-,2320	,9102
		2.00	,22137	,22539	,760	-,3605	,8033
		4.00	-,21429	,33794	,921	-1,0868	,6582
	4.00	1.00	,55337	,27695	,191	-,1617	1,2684
		2.00	,43566	,28032	,406	-,2881	1,1594
		3.00	,21429	,33794	,921	-,6582	1,0868
Do you have any experience leading groups?	1.00	2.00	.27298*	,08473	,008	,0542	,4918
		3.00	,41369	,16036	,050	-,0004	,8278
		4.00	,03170	,20066	,999	-,4864	,5498
	2.00	1.00	-.27298*	,08473	,008	-,4918	-,0542
		3.00	,14071	,16350	,825	-,2815	,5629
		4.00	-,24128	,20318	,635	-,7659	,2834
	3.00	1.00	-,41369	,16036	,050	-,8278	,0004
		2.00	-,14071	,16350	,825	-,5629	,2815

		4.00	-,38199	,24458	,402	-1,0135	,2496
	4.00	1.00	-,03170	,20066	,999	-,5498	,4864
		2.00	,24128	,20318	,635	-,2834	,7659
		3.00	,38199	,24458	,402	-,2496	1,0135
leading-where	1.00	2.00	-,45419	,31514	,475	-1,2710	,3626
		3.00	-,03846	,51981	1,000	-1,3858	1,3088
		4.00	-,66346	,75430	,815	-2,6185	1,2916
	2.00	1.00	,45419	,31514	,475	-,3626	1,2710
		3.00	,41573	,51348	,850	-,9152	1,7466
		4.00	-,20927	,74995	,992	-2,1531	1,7345
	3.00	1.00	,03846	,51981	1,000	-1,3088	1,3858
		2.00	-,41573	,51348	,850	-1,7466	,9152
		4.00	-,62500	,85634	,885	-2,8446	1,5946
	4.00	1.00	,66346	,75430	,815	-1,2916	2,6185
		2.00	,20927	,74995	,992	-1,7345	2,1531
		3.00	,62500	,85634	,885	-1,5946	2,8446
manager-dummy	1.00	2.00	,02210	,01975	,678	-,0289	,0731
		3.00	-.17234*	,03196	,000	-,2548	-,0899
		4.00	-,09555	,04442	,139	-,2102	,0191
	2.00	1.00	-,02210	,01975	,678	-,0731	,0289
		3.00	-.19444*	,03275	,000	-,2790	-,1099
		4.00	-.11765*	,04499	,046	-,2338	-,0015
	3.00	1.00	.17234*	,03196	,000	,0899	,2548
		2.00	.19444*	,03275	,000	,1099	,2790
		4.00	,07680	,05153	,444	-,0562	,2098
	4.00	1.00	,09555	,04442	,139	-,0191	,2102
		2.00	.11765*	,04499	,046	,0015	,2338
		3.00	-,07680	,05153	,444	-,2098	,0562
leading-years-Other	1.00	2.00	,11205	,17374	,917	-,3437	,5678
		3.00	-,66977	,35471	,241	-1,6002	,2607
		4.00	-,81977	,39243	,165	-1,8492	,2096
	2.00	1.00	-,11205	,17374	,917	-,5678	,3437
		3.00	-,78182	,36027	,140	-1,7269	,1632
		4.00	-,93182	,39746	,097	-1,9744	,1108
	3.00	1.00	,66977	,35471	,241	-,2607	1,6002
		2.00	,78182	,36027	,140	-,1632	1,7269
		4.00	-,15000	,50360	,991	-1,4710	1,1710
	4.00	1.00	,81977	,39243	,165	-,2096	1,8492
		2.00	,93182	,39746	,097	-,1108	1,9744
		3.00	,15000	,50360	,991	-1,1710	1,4710
DS_CogAb_q3	1.00	2.00	-,04452	,12086	,983	-,3567	,2676
		3.00	-,30394	,23050	,552	-,8992	,2913
		4.00	-,12212	,31629	,980	-,9390	,6947
	2.00	1.00	,04452	,12086	,983	-,2676	,3567
		3.00	-,25942	,23516	,688	-,8668	,3479
		4.00	-,07761	,31971	,995	-,9033	,7481
	3.00	1.00	,30394	,23050	,552	-,2913	,8992
		2.00	,25942	,23516	,688	-,3479	,8668
		4.00	,18182	,37514	,962	-,7871	1,1507
	4.00	1.00	,12212	,31629	,980	-,6947	,9390
		2.00	,07761	,31971	,995	-,7481	,9033
		3.00	-,18182	,37514	,962	-1,1507	,7871

DS_Educat_q2	1.00	2.00	-,10175	,14704	,900	-,4814	,2779
		3.00	-,00610	,28064	1,000	-,7307	,7185
		4.00	-,13033	,35126	,983	-1,0373	,7766
	2.00	1.00	,10175	,14704	,900	-,2779	,4814
		3.00	,09565	,28584	,987	-,6424	,8337
		4.00	-,02857	,35543	1,000	-,9463	,8892
	3.00	1.00	,00610	,28064	1,000	-,7185	,7307
		2.00	-,09565	,28584	,987	-,8337	,6424
		4.00	-,12422	,42833	,991	-1,2302	,9817
	4.00	1.00	,13033	,35126	,983	-,7766	1,0373
		2.00	,02857	,35543	1,000	-,8892	,9463
		3.00	,12422	,42833	,991	-,9817	1,2302
DS_Pract_q3	1.00	2.00	,19883	,13066	,426	-,1385	,5362
		3.00	,44521	,24883	,280	-,1973	1,0877
		4.00	,46074	,31145	,451	-,3434	1,2649
	2.00	1.00	-,19883	,13066	,426	-,5362	,1385
		3.00	,24638	,25359	,766	-,4084	,9011
		4.00	,26190	,31526	,840	-,5521	1,0759
	3.00	1.00	-,44521	,24883	,280	-1,0877	,1973
		2.00	-,24638	,25359	,766	-,9011	,4084
		4.00	,01553	,37978	1,000	-,9651	,9961
	4.00	1.00	-,46074	,31145	,451	-1,2649	,3434
		2.00	-,26190	,31526	,840	-1,0759	,5521
		3.00	-,01553	,37978	1,000	-,9961	,9651
PA_Lead_q3	1.00	2.00	,05549	,12626	,972	-,2704	,3814
		3.00	-,05357	,22135	,995	-,6250	,5178
		4.00	,10734	,29713	,984	-,6597	,8743
	2.00	1.00	-,05549	,12626	,972	-,3814	,2704
		3.00	-,10907	,22614	,963	-,6928	,4747
		4.00	,05185	,30072	,998	-,7244	,8281
	3.00	1.00	,05357	,22135	,995	-,5178	,6250
		2.00	,10907	,22614	,963	-,4747	,6928
		4.00	,16092	,35141	,968	-,7462	1,0680
	4.00	1.00	-,10734	,29713	,984	-,8743	,6597
		2.00	-,05185	,30072	,998	-,8281	,7244
		3.00	-,16092	,35141	,968	-1,0680	,7462
PA_Confid_q3	1.00	2.00	-,11044	,16313	,906	-,5318	,3109
		3.00	,04107	,31111	,999	-,7624	,8446
		4.00	,58653	,42691	,517	-,5160	1,6891
	2.00	1.00	,11044	,16313	,906	-,3109	,5318
		3.00	,15152	,31741	,964	-,6683	,9713
		4.00	,69697	,43152	,372	-,4175	1,8115
	3.00	1.00	-,04107	,31111	,999	-,8446	,7624
		2.00	-,15152	,31741	,964	-,9713	,6683
		4.00	,54545	,50635	,704	-,7623	1,8532
	4.00	1.00	-,58653	,42691	,517	-1,6891	,5160
		2.00	-,69697	,43152	,372	-1,8115	,4175
		3.00	-,54545	,50635	,704	-1,8532	,7623
DS_PerCom_q3	1.00	2.00	,14049	,12844	,694	-,1911	,4721
		3.00	-,11670	,24514	,964	-,7497	,5163
		4.00	-,20677	,30683	,907	-,9990	,5855
	2.00	1.00	-,14049	,12844	,694	-,4721	,1911

		3.00	-,25719	,24968	,732	-,9019	,3875
		4.00	-,34725	,31047	,678	-1,1489	,4544
	3.00	1.00	,11670	,24514	,964	-,5163	,7497
		2.00	,25719	,24968	,732	-,3875	,9019
		4.00	-,09006	,37416	,995	-1,0561	,8760
	4.00	1.00	,20677	,30683	,907	-,5855	,9990
		2.00	,34725	,31047	,678	-,4544	1,1489
		3.00	,09006	,37416	,995	-,8760	1,0561
DS_ProjMan_q2	1.00	2.00	-,12381	,11611	,710	-,4237	,1760
		3.00	,13746	,22142	,925	-,4344	,7093
		4.00	-,27163	,30384	,808	-1,0563	,5131
	2.00	1.00	,12381	,11611	,710	-,1760	,4237
		3.00	,26127	,22591	,655	-,3222	,8447
		4.00	-,14782	,30712	,963	-,9410	,6454
	3.00	1.00	-,13746	,22142	,925	-,7093	,4344
		2.00	-,26127	,22591	,655	-,8447	,3222
		4.00	-,40909	,36038	,668	-1,3398	,5216
	4.00	1.00	,27163	,30384	,808	-,5131	1,0563
		2.00	,14782	,30712	,963	-,6454	,9410
		3.00	,40909	,36038	,668	-,5216	1,3398
DS_Pract_q4	1.00	2.00	-,35160	,13926	,058	-,7112	,0080
		3.00	-1.16832*	,26579	,000	-1,8546	-,4820
		4.00	-,76149	,33268	,103	-1,6205	,0975
	2.00	1.00	,35160	,13926	,058	-,0080	,7112
		3.00	-.81672*	,27071	,015	-1,5157	-,1177
		4.00	-,40989	,33662	,616	-1,2791	,4593
	3.00	1.00	1.16832*	,26579	,000	,4820	1,8546
		2.00	.81672*	,27071	,015	,1177	1,5157
		4.00	,40683	,40567	,748	-,6406	1,4543
	4.00	1.00	,76149	,33268	,103	-,0975	1,6205
		2.00	,40989	,33662	,616	-,4593	1,2791
		3.00	-,40683	,40567	,748	-1,4543	,6406
PA_Respon_q3	1.00	2.00	,04667	,12510	,982	-,2764	,3698
		3.00	,18784	,23858	,860	-,4283	,8040
		4.00	,36966	,32738	,672	-,4759	1,2152
	2.00	1.00	-,04667	,12510	,982	-,3698	,2764
		3.00	,14117	,24341	,938	-,4875	,7698
		4.00	,32299	,33092	,763	-,5317	1,1776
	3.00	1.00	-,18784	,23858	,860	-,8040	,4283
		2.00	-,14117	,24341	,938	-,7698	,4875
		4.00	,18182	,38830	,966	-,8210	1,1847
	4.00	1.00	-,36966	,32738	,672	-1,2152	,4759
		2.00	-,32299	,33092	,763	-1,1776	,5317
		3.00	-,18182	,38830	,966	-1,1847	,8210
PA_Openn_q3	1.00	2.00	-,01215	,09435	,999	-,2558	,2315
		3.00	-,17087	,17951	,777	-,6345	,2928
		4.00	,01095	,24633	1,000	-,6252	,6472
	2.00	1.00	,01215	,09435	,999	-,2315	,2558
		3.00	-,15872	,18326	,822	-,6320	,3146
		4.00	,02310	,24907	1,000	-,6202	,6664
	3.00	1.00	,17087	,17951	,777	-,2928	,6345
		2.00	,15872	,18326	,822	-,3146	,6320

		4.00	,18182	,29217	,925	-,5728	,9364
	4.00	1.00	-,01095	,24633	1,000	-,6472	,6252
		2.00	-,02310	,24907	1,000	-,6664	,6202
		3.00	-,18182	,29217	,925	-,9364	,5728
DS_Educat_q3	1.00	2.00	-,10596	,09489	,679	-,3509	,1390
		3.00	-.59536*	,16635	,002	-1,0248	-,1660
		4.00	-,13559	,22331	,930	-,7120	,4408
	2.00	1.00	,10596	,09489	,679	-,1390	,3509
		3.00	-.48940*	,16996	,022	-,9281	-,0507
		4.00	-,02963	,22600	,999	-,6130	,5538
	3.00	1.00	.59536*	,16635	,002	,1660	1,0248
		2.00	.48940*	,16996	,022	,0507	,9281
		4.00	,45977	,26410	,304	-,2220	1,1415
	4.00	1.00	,13559	,22331	,930	-,4408	,7120
		2.00	,02963	,22600	,999	-,5538	,6130
		3.00	-,45977	,26410	,304	-1,1415	,2220
DS_IntCom_q3	1.00	2.00	,02159	,09082	,995	-,2129	,2560
		3.00	,19988	,15923	,592	-,2111	,6109
		4.00	,14011	,21374	,914	-,4116	,6919
	2.00	1.00	-,02159	,09082	,995	-,2560	,2129
		3.00	,17829	,16268	,692	-,2416	,5982
		4.00	,11852	,21632	,947	-,4399	,6769
	3.00	1.00	-,19988	,15923	,592	-,6109	,2111
		2.00	-,17829	,16268	,692	-,5982	,2416
		4.00	-,05977	,25279	,995	-,7123	,5928
	4.00	1.00	-,14011	,21374	,914	-,6919	,4116
		2.00	-,11852	,21632	,947	-,6769	,4399
		3.00	,05977	,25279	,995	-,5928	,7123
DS_Pract_q5	1.00	2.00	-,12611	,09635	,558	-,3750	,1227
		3.00	-.50712*	,18375	,031	-,9817	-,0325
		4.00	,17470	,25215	,900	-,4765	,8259
	2.00	1.00	,12611	,09635	,558	-,1227	,3750
		3.00	-,38101	,18747	,178	-,8652	,1032
		4.00	,30081	,25487	,640	-,3574	,9591
	3.00	1.00	.50712*	,18375	,031	,0325	,9817
		2.00	,38101	,18747	,178	-,1032	,8652
		4.00	,68182	,29907	,105	-,0906	1,4542
	4.00	1.00	-,17470	,25215	,900	-,8259	,4765
		2.00	-,30081	,25487	,640	-,9591	,3574
		3.00	-,68182	,29907	,105	-1,4542	,0906
DS_ProjMan_q3	1.00	2.00	,01727	,11014	,999	-,2671	,3016
		3.00	-,04373	,20975	,997	-,5853	,4978
		4.00	-,33876	,26253	,570	-1,0166	,3391
	2.00	1.00	-,01727	,11014	,999	-,3016	,2671
		3.00	-,06100	,21376	,992	-,6129	,4909
		4.00	-,35604	,26575	,538	-1,0422	,3301
	3.00	1.00	,04373	,20975	,997	-,4978	,5853
		2.00	,06100	,21376	,992	-,4909	,6129
		4.00	-,29503	,32014	,793	-1,1216	,5316
	4.00	1.00	,33876	,26253	,570	-,3391	1,0166
		2.00	,35604	,26575	,538	-,3301	1,0422
		3.00	,29503	,32014	,793	-,5316	1,1216

PA_Confid_q4	1.00	2.00	,09433	,10408	,802	-,1745	,3631
		3.00	-,28039	,19850	,492	-,7930	,2323
		4.00	-,00767	,27238	1,000	-,7111	,6958
	2.00	1.00	-,09433	,10408	,802	-,3631	,1745
		3.00	-,37472	,20251	,252	-,8978	,1483
		4.00	-,10200	,27532	,983	-,8131	,6091
	3.00	1.00	,28039	,19850	,492	-,2323	,7930
		2.00	,37472	,20251	,252	-,1483	,8978
		4.00	,27273	,32306	,833	-,5616	1,1071
	4.00	1.00	,00767	,27238	1,000	-,6958	,7111
		2.00	,10200	,27532	,983	-,6091	,8131
		3.00	-,27273	,32306	,833	-1,1071	,5616

***. The mean difference is significant at the 0.05 level.**

c) Reliability Statistics

Reliability Statistics

Cronbach's Alpha	N of Items
,421	67

d) Exploratory Factor Analysis (EFA)

*grouped DPI categories based on edu-level

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
DS_CogAb	Between Groups	,782	3	,261	,341	,796
	Within Groups	292,402	382	,765		
	Total	293,184	385			
DS_CogStr	Between Groups	1,724	3	,575	,722	,539
	Within Groups	303,883	382	,796		
	Total	305,607	385			
DS_PerCom_q1	Between Groups	6,345	3	2,115	2,350	,072
	Within Groups	343,773	382	,900		
	Total	350,118	385			
DS_IntCom	Between Groups	13,388	3	4,463	5,618	,001
	Within Groups	303,418	382	,794		
	Total	316,806	385			
DS_Pract	Between Groups	24,015	3	8,005	7,142	,000
	Within Groups	428,132	382	1,121		
	Total	452,147	385			
DS_Educat	Between Groups	1,138	3	,379	,491	,689
	Within Groups	295,123	382	,773		
	Total	296,261	385			

DS_Manager	Between Groups	3,672	3	1,224	1,839	,140
	Within Groups	254,229	382	,666		
	Total	257,901	385			
DS_ProjMan	Between Groups	34,857	3	11,619	10,025	,000
	Within Groups	442,748	382	1,159		
	Total	477,604	385			
PA_Emotion	Between Groups	17,646	3	5,882	8,013	,000
	Within Groups	280,427	382	,734		
	Total	298,073	385			
PA_Openn	Between Groups	18,017	3	6,006	6,306	,000
	Within Groups	363,824	382	,952		
	Total	381,841	385			
PA_SocAb	Between Groups	,954	3	,318	,437	,726
	Within Groups	277,609	382	,727		
	Total	278,562	385			
PA_Lead	Between Groups	3,796	3	1,265	1,749	,157
	Within Groups	276,444	382	,724		
	Total	280,240	385			
PA_Ethic	Between Groups	24,229	3	8,076	6,099	,000
	Within Groups	505,822	382	1,324		
	Total	530,051	385			
PA_Confid	Between Groups	23,913	3	7,971	9,061	,000
	Within Groups	336,027	382	,880		
	Total	359,940	385			
PA_Respon	Between Groups	65,093	3	21,698	15,130	,000
	Within Groups	547,831	382	1,434		
	Total	612,924	385			

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,935
Bartlett's Test of Sphericity	Approx. Chi-Square	3905,662
	df	105
	Sig.	0,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	7,398	49,322	49,322	7,398	49,322	49,322	6,680
2	2,216	14,774	64,096	2,216	14,774	64,096	5,561
3	,901	6,004	70,100				
4	,599	3,995	74,096				
5	,535	3,569	77,665				
6	,504	3,358	81,023				
7	,456	3,038	84,060				
8	,435	2,898	86,958				
9	,393	2,617	89,575				
10	,361	2,405	91,981				
11	,341	2,272	94,253				
12	,286	1,908	96,161				
13	,241	1,610	97,771				
14	,181	1,204	98,975				
15	,154	1,025	100,000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix[a]		
	Component	
	1	2
PA_Emotion	,836	-,178
DS_IntCom	,808	-,122
PA_Openn	,799	
DS_Pract	,745	,542
DS_PerCom_q1	,739	-,129
DS_ProjMan	,731	,542
DS_CogStr	,719	-,307
DS_Educat	,699	-,328
PA_SocAb	,674	-,352

Linear Regression of Professional Identity and DPI elements

Beginners

Regression Statistics	
Multiple R	0,34
R Square	0,12
Adjusted R Square	0,03
Standard Error	20,28
Observations	161

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15,00	7883,21	525,55	1,28	0,22
Residual	145,00	59646,39	411,35		
Total	160,00	67529,60			

	Coefficients (β)	*St.Error*	*t Stat*	*P-value*
Intercept	49,27	24,06	2,05	0,04
PA_Confid_q2	2,74	2,65	1,03	0,30
PA_Emotion_q1	-2,09	2,31	-0,90	0,37
PA_Ethic_q2	-0,14	1,91	-0,07	0,94
PA_Leadership_q1	0,91	2,62	0,35	0,73
PA_Openn_q2	-4,09**	1,94	-2,11	0,04
PA_Respon_q2	1,36	3,30	0,41	0,68
PA_SocialAb_q2	2,09	2,30	0,91	0,37
DS_CogAb_q2	2,35	2,57	0,91	0,36
DS_CogStr_q1	-0,33	2,23	-0,15	0,88
DS_PerCom_q1	-1,88	1,77	-1,06	0,29
DS_IntCom_q2	1,16	1,81	0,64	0,52
DS_Educat_q2	0,64	3,26	0,20	0,84
DS_Pract_q2	5,18***	2,10	2,46	0,01
DS_Manager_q1	-1,05	2,17	-0,48	0,63
DS_ProjMan_q2	-0,05	1,90	-0,03	0,98

Intermediates

Regression Statistics	
Multiple R	0,39
R Square	0,15
Adjusted R Square	0,02
Standard Error	16,56
Observations	113

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15,00	4864,88	324,33	1,18	0,30
Residual	97,00	26606,57	274,29		
Total	112,00	31471,45			

	Coefficients (β)	*St.Error*	*t Stat*	*P-value*
Intercept	92,58	21,63	4,28	0,00
PA_Confid_q2	-3,40	2,77	-1,23	0,22
PA_Emotion_q1	-0,89	2,22	-0,40	0,69
PA_Ethic_q2	-2,25	1,97	-1,14	0,26
PA_Leadership_q1	0,67	2,90	0,23	0,82
PA_Openn_q2	-2,00	2,00	-1,00	0,32
PA_Respon_q2	-8,20**	3,42	-2,40	0,02
PA_SocialAb_q2	-0,57	2,39	-0,24	0,81
DS_CogAb_q2	0,73	2,31	0,32	0,75
DS_CogStr_q1	2,54	2,25	1,13	0,26

DS_PerCom_q1	4,82***	1,76	2,74	0,01
DS_IntCom_q2	-2,46	2,14	-1,15	0,25
DS_Educat_q2	1,92	3,34	0,57	0,57
DS_Pract_q2	2,12	2,28	0,93	0,35
DS_Manager_q1	0,89	2,10	0,43	0,67
DS_ProjMan_q2	-2,94	2,11	-1,40	0,17

Professionals

Regression Statistics	
Multiple R	0,81
R Square	0,66
Adjusted R Square	0,19
Standard Error	21,12
Observations	27

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15,00	9489,57	632,64	1,42	0,28
Residual	11,00	4906,95	446,09		
Total	26,00	14396,52			

	Coefficients (β)	*St.Error*	*t Stat*	*P-value*
Intercept	51,20	90,17	0,57	0,58
PA_Confid_q2	-12,56	11,17	-1,12	0,28
PA_Emotion_q1	-18,78*	9,57	-1,96	0,08
PA_Ethic_q2	9,41	6,74	1,40	0,19
PA_Lead_q1	0,19	10,75	0,02	0,99
PA_Openn_q2	4,14	8,11	0,51	0,62
PA_Respon_q2	-10,03	9,14	-1,10	0,30
PA_SocialAb_q2	-7,56	10,96	-0,69	0,50
DS_CogAb_q2	0,84	10,78	0,08	0,94
DS_CogStr_q1	6,49	8,05	0,81	0,44
DS_PerCom_q1	7,17	7,19	1,00	0,34
DS_IntCom_q2	0,33	6,92	0,05	0,96
DS_Educat_q2	13,63	8,48	1,61	0,14
DS_Pract_q2	12,06	8,04	1,50	0,16
DS_Manager_q1	-8,47	6,82	-1,24	0,24
DS_ProjMan_q2	0,31	5,44	0,06	0,96

5.7.5 Means of Ranking DS

	BEGINNER_SCORE		**INTERMEDIATE_SCORE**		**PROFESSIONAL_SCORE**	
	mean	rank	mean	rank	mean	rank
RANK-COGAB	2,89	8	2,72	8	3,29	7
RANK-COGSTR	3,35	6	3,16	6	3,69	6
RANK-PERCOMM	3,74	2	3,46	4	4,08	2
RANK-INTERCOMM	3,72	3	3,65	2	3,81	4
RANK-EDUKNOWL	3,44	5	3,16	5	4,05	3
RANK-PRACTKNOWL	4,16	1	4,03	1	4,41	1
RANK-MANCOMP	2,96	7	2,75	7	3,11	8
RANK-PROJMAN	3,65	4	3,51	3	3,77	5

5.7.6 Qualitative Coding: why-design

In this example, **Beginners** (edu-level=1, n=155) explain **why did they choose design as a profession** (why-design). The answers were classifies by Axial Coding into four different reasons, and allocated in the following categories:

To apply creativity - Quotes (edu-level=1, **n=61)**	
1.	Because I like to make things
2.	I love the combination of being creative, and designing good products.
3.	Because I like to be creative, but didn't want to go to an artschool
4.	I am a creative person and I really want to express that
5.	because for some reason i really like making something that people like to look at and want to use that is different from what is already there
6.	Because I wanted to combine something technical with creativity
7.	Because I like to be innovative and to create something new.
8.	Because from the age of 5 I was already drawing new things (buidlings etc) and I am good in making things.
9.	Because I like the creativity
10.	I'd like to realize the ideas i have in my head
11.	I like to create and especially to create something that can help other people, i'm mostly interested in Medesign and I hope that I can work in that field when I graduate
12.	like to be creative and actif mind
13.	Because I love to be creative and I'm sure i would miss it if I did a study without using your creativity.
14.	I like to create
15.	I want to use my inspiration, thoughts, feelings to make something that will help others. I want to make design that will improve lives or tells a story.
16.	I the idea of making somthing which youve spent so much time on, then seeing it in someones hand with a smile on their face.
17.	Because I have a creative mind
18.	I was interested in creating new things with a creative mind
19.	because I like being creative
20.	Because I always loved to craft and wanted to do something with it.
21.	because i like to build tings
22.	Because I love being creative, working as wel as thinking, and also make products for people (to make life better).
23.	I Liked to think of new things
24.	i AM INTERESTED IN DESIGN AND i LIKE TO BE CREATIVE AND MAKE THINGS
25.	So I could make things. I want to be able to turn an idea I have in my head into reality
26.	I chose design since I really like creating things and making ideas come to life. I'm also quite a caring person, I really like helping people and hope that I can design products and systems to improve other people's well-being.
27.	I like the creative aspect where you create an actual result. You don't just stop at ideas or theories, but you actually create touchable/usable things
28.	I like to create things
29.	to combine my creativity and love for aesthetics with the technology direction I followed at secondary school. To design aesthetic and useful products to help people in their daily life, and to have a hand in the future through innovation
30.	Because I like to be creative, but also to know what is the goal and to make sure that it's feasible
31.	To be able to make my mark on the design industry with my specific style.
32.	I love to see ideas in my head turn into things in the real world
33.	Because I like being creative and its something that I get motivated and energised by every single time
34.	I like the creative process
35.	To ve creative and new-thinking
36.	I like the idea of being able to create and be innovative with new products and/or improvements on existing products
37.	Because I love being a part of creative processes.
38.	To innovate
39.	I want to create

40.	Because i think its a lot of fun to use my creative skills in a way that matters. Seeing the stuff you think about exist in real life.
41.	I like to create.
42.	Cause i like visual design.
43.	To get creative and solutionoriented
44.	Because i like to get ideas, im good at it. And i like to actually make the ideas. Also i like to talk to the user, and design for them/solving their problems
45.	i like to create solutions and be creative
46.	design is a creative outlet that doesn't restrict you to a certain field. i am a creator and a learner who loves to create, if its clothes, art, a toothbrush or an industrial filter i dont really care, i like the satisfaction you get from creating, changing and improving and learning, especially in fields i dont know much about beforehand.
47.	To create new and/or inproved products
48.	Creating new stuff is fun, and i feel inspired by watching amazing product created by others, and i feel proud about the things i designed myself
49.	I started at KADK because I thought I would create beautiful things, but I learned that I wanted to make the everyday life easier for people so I quit KADK and started at Design and Innovation in order to understand the user and the social aspects in design.
50.	To create
51.	To use my creativity and to make things with my own mind and body.
52.	I love to innovate
53.	I choose Design, because of the problem solving and the ability to create something unique and useful
54.	Because I like to be creative, solve problems, create and also work with different projekts all the time. I like to be in a field where I can keep learning and where I will always evolve. It's and interesting and always changing field.
55.	I like to create and being creative. The idea of create something beautiful, helpful etc. gets me motivated.
56.	I like being creative and designing things. / Other then that it is also a good field to study if you want to start up your own company.
57.	To be able to create
58.	Because of the creative aspect of a design ingeneer
59.	I choose design because i find it interresting. Because i want to use my creativity. I want to create solutions.
60.	Because i like to be creative and work with other people.
61.	To create

To Combine Skills - Quotes (edu-level=1, **n=32)**	
1.	the variety that comes along
2.	Because of the varied set of competences needed
3.	Because it is such a broad field where you can work in.
4.	Because I like the combination of the different aspects like creativity, technology and management. Also I think it's nice how we can help people and improve the world through design.
5.	Because it is a mix between science and creativity
6.	The combination of technology and creativity.
7.	It combines creativity and technology in a fun and useful course.
8.	Because it is a mix of marketing, creativity and technology.
9.	both creative and technical
10.	to expres my creativity in combination with engineering
11.	I like the creativity and functionallity combined.
12.	to be creative and technical
13.	Combination between technology and creativity
14.	Combination of arts and science
15.	The possibility to create something from scratch and to do that trough connecting different knowledge
16.	I like combining creativity with technology
17.	I like the social and technical aspects of this profession
18.	I wanted to study a combi of technical , social/human, and creative aspects. I used to study medicine, but I missed the technical and the creative aspects. Therefore I switched.
19.	Because I like to combine technology and creativity to create something useful for society.
20.	To bring art and function closer to eachother
21.	The combination of creative/aesthetic skills and the user knowledge and technical knowledge

22.	Creativity + technical skills
23.	Because it's interesting. It combines a lot of different fields and knowledge.
24.	People and technical stuff in combination
25.	To study something that is a mix between faculties. You can't be a good designer without knowing people.
26.	I think it is interesting to combind the technical and aestetical field and especially learn more about the technical aspect to make better solutions.
27.	Because of the mix of the creative and the technical.
28.	To combine creativity and artistic abilities whit more technical knowledge, and to find solutions!
29.	To combine different theories and technical abilities with creativity and getting to see a visual end result of your work.
30.	The reason why I have to become af design-engineer is, that i would love to get both the design aspects of product development as well as the engineering aspects
31.	I like to be innovative and use Itin many different contexts. Also I like the technical parts of designing.
32.	creativity and technology combined

To Create Impact - Quotes (edu-level=1, **n=26)**	
1.	Because it is interesting to create a product which is appreciated by customers and really can make a difference
2.	Because I want to improve the world
3.	I like to design something for people, to help them and I like technique.
4.	because I like to be creative and because I would like to help people through my desings
5.	to develop products that influence the world for the better. especially when it comes to sustainability and helping people in need.
6.	Because I want to make the world a better place and I like the way I can express my creativity through industrial design
7.	I like the combination between the appearance of the design, the technology behind it and the human aspect. I like to help people by making designs.
8.	Because I want to make impact changes, mostly concerning environmental issues
9.	i like to think about making products/services better
10.	I really liked the creative subjects in High school, but I also was really good at all the technical subjects. Besides I really would like to make a difference in the world and I think design is a good way to achieve that.
11.	I wanted to create smart solutions for the future using technological advancements to create more sustainable products.
12.	Because it's something I've always thought about (even before I knew this education existed). I can make everyday lives easier.
13.	To fulfil consumer needs by integrative thinking and bring together multiple parties and perspectives, and to develop ideas and use my creativity.
14.	i wanted to bring improvement to the world i live in
15.	Because you actually make something
16.	When things have been designed in a dumb way it bothers me a lot, I want to be able to replace those products and improve them
17.	I like the interaction between people and products. I like good products.
18.	Because I find it interesting to work with people and being able to help people with my ideas.
19.	I chose design as I find it interesting to improve products with focus on the user.
20.	Because I want to be able to design and develop products for a good purpose.
21.	I like to work in groups and I want to be able to work creative - I draw a lot and uses it to communicate. I want to make a better world, and I can to that through design.
22.	I like the idea of making products that take the user and situation in consideration. I like to solve problems and lerning about new problems
23.	Want to create the Day of tomorrow
24.	I want to change to world. I know that's more than I'll be able to, so I want to make local change. My dream is to work with 3rd world development and improve the lives of the many people who are less fortunate than I, than us. My hope is that I with Design will be able to introduce concepts, methods, ideas, products that can improve the lives of people in a meaningful way. I'm not interested in aesthetics, I'm interested in meaningful change.
25.	design is connecting people - i like both people and technics - and i like the way a designer can form their own way of do their job
26.	Because of the people aspect

To Challenge Intellect - Quotes (edu-level=1, **n=23)**	
1.	Because of its accurateness
2.	Interesting
3.	because it has a balance between technics and creativity on a challanging level
4.	because i thought the study was interessting
5.	I always like technical stuff, but i wanted to do something with humans and with creativity too.
6.	I always wonder about the objects around me how were they made and why, I always wanted to know more about it and Industrial design was the right program to do it
7.	I like to think about aesthetics and function of a product and to investigate the way to change this.
8.	Because I like the creative part, to solve problems.
9.	I enjoy thinking about problems and finding solutions for them. And I also really like design in general.
10.	Because it can go so many different ways
11.	Because I like to express myself creatively and I am very interested in the logic behind products
12.	Because I like to try to solve problems by brainstorming (with a group) and create things I have come up with.
13.	It inspires me
14.	I think it's interesting and challenging
15.	Fascinating to improve products. I like UX.
16.	Because I love problem solving
17.	i like the idea of innovation and to be able to solve complex problems
18.	I think it's very interesting to know how things are made, and I found the idea of contributing to making more product intriguing
19.	Ever since i have been a child, i have had the intrest of the construction of verius things
20.	I love beeing creative, i love the endless possibilities when starting a project, i like to invent, to search for "the real reasons/problems" behind products. At the same time i find sience interesting and like to be able to calculate if the things i design can work and so on.
21.	I love solving practical problems and have a good imagination in that regard.
22.	I like to make concrete products and work on projects. / I think that a lot of problems can be fixed through better design and I want to do just that.
23.	I Chose design becuase i Luke THE process behind creating a product. From the start, a given problem or an impulsive idea to the end a Production or even owning a startup Company bases on the final product/service

Other reasons - Quotes (edu-level=1, **n=13)**	
1.	to be fair i didnt know what i wanted to do
2.	because i liky like
3.	I like it
4.	I find it interesting and like the idea of me being an innovation.
5.	I find it interesting. I don't want an ordinary job
6.	because I find it very interresting
7.	Because I enjoy design and working with it.
8.	I wanna develop sports equitment
9.	I think it fits me
10.	i need the diploma to be taken seriously
11.	Because I want to work with designing when I get older.
12.	I find it interresting.
13.	1. My cousin studied it, and after speaking to him - i just found it really interesting. / 2. I'd like to create my own business/product, so i thought it would be a good education to do that with.

5.7.7 Qualitative Coding: why-dropout

In the table below, all the responses from **Drop-outs** (edu-level=4, n=17) are listed in order to explain **why did they decide to take another path besides Design?** (why-dropout). The answers were classifies by Axial Coding into four different reasons, and allocated in the following categories:

Categories	Reasons	Quotes (edu-level=4, **n=17)**
Demotivational Triggers a) Lack of Jobs (No Jobs) b) Changes of interest (New Interests)	No Job	1. My first degree was in Mechanical Engineering. I took a masters in Design and Innovation, and I would like to find a job on the field, but I happen to find a job within the mechanical engineering field, so I took it.
	No Job	2. I took the first job I were offered (I finished my study during the financial crisi in DK).
	No Job	3. Happened a bit accidental. When I graduated I got a job as a engineer and latter as a departmental manager in the phamaceutical industri. It has nothing to do with design but has been a great lerning experience as a manager/leader. Now I want to go back to Product Development/design. When I graduated in 2013 I did not dare to wait for the "right" job within product Development. Now in 2016 the situation is different with more new jobs in the field.
	No Job	4. I couldn't find a job in design
	No Job	5. I couldn't find any job and I was working as a freelance graphic designer which is somehow frustrating after some time, especially dealing with clients that always delay the payment. Since I was supposed to live thanks to my job I was forced to switch to other random jobs.
	New interests	6. During my student jobs and internships I discovered a passion for the commercial/business side of things which pulled me in that direction. Personally I felt the hard core design stuff became to nitty-gritty and to theoretical and out of touch with the real world. When I didn't think stuff we were doing would survive in the real world my motivation disappeared.
	New interests	7. I only took the Bachelor in Design and Innovation, after which i switched to a Masters in Sustainable Energy. / The switch was made because I felt that there was to little engineering in the education, and the Masters part of the Design and Innovation track seemed to be more of the same as the bachelor courses, instead of something new.
	New interests	8. After the BA in Design & Innovation I had the feeling of not digging deep enough into the matter. Thus changed to Material Techonology, also DTU, to specialize further.

Categories	Reasons	Quotes (edu-level=4, **n=17)**
Professional Identification Issues a) Lack of perceived related daily activities (Non related daily activities) b) Confusion and difficulties regarding *design* as terminology (Terminology &	Non related daily activities	9. It depends on the definition of design. I work with User Experience Research, which is more research and IT development related than design. I use many principle from design, but I am not strictly working with it (much more with data analysis and programming)
	Non related daily activities	10. Design is many things so I will not say that I deliberately chose not to design. / In my masters thesis I wrote about designing an occupational health and safety management system and I have been working with occupational health and safety since.
	Non related daily activities	11. I got an interesting job and here the design aspects are not as fundamentals as during the education. But I would say, that I still use it in some contects.
	Non related daily activities	12. I wanted to get into tech and I found it easier to get into this field by doing software development than UX design. There are more SW developer jobs than UX design jobs, thus I decided to become a SW developer. However, I mostly work with front end engineering, meaning that I kind of use my design skills still. I'm planning later in my career to become UX designer again or Product manager, which will utilize some of the skills I learned at DTU

	Non related daily activities	13. First I would like to dispute the main assumption in this survey that being a graduate from DTU Design & Innovation ever had me feel like a "designer". I have always considered myself a "product developer". / / After I graduated I worked with a few minor actual design (as in development) tasks in a big research company. I quickly changed role to being more involved in identification of user needs and early concept development. Gradually my focus and interests changed towards project management - a career path I am slowly but steadily getting more rooted in.
	Terminology & Roles	14. I wasn't going for design (drawing related) work anyway. Even during the education, I wasn't interested in Design in terms aesthetics or something similar. I learned many useful things, however, I wasn't interested in drawing or CAD work. Luckily "design" is a broad term, and I still make use of many of the tools I have acquired during the education. / / I also wouldn't count Design & Innovation at DTU as a "design" program. It is an engineering program, and design is thought of as stated above as something broad. It makes it difficult to compare to other programs that also are "design" programs. There is also a semantic difference in the use of Design in English and Danish, that also cause confusion. I prefer the English sense of the word. / / I also wouldn't count Design & Innovation at DTU as a "design" program. It is an engineering program, and design is thought of as stated above as something broad. It makes it difficult to compare to other programs that also are "design" programs. There is also a semantic difference in the use of Design in English and Danish, that also cause confusion. I prefer the English sense of the word.
	Terminology & Roles	15. I still think that I use my design thinking skills regularly as a university administrator. / / I think the idea that you have to work as a "designer" is outdated. Any situation where you work with complex problem solving is doing design work, and needing to engage multiple stakeholders to reach a shared solution is important.
	Terminology & Roles	16. I do not consider my education a design education, by which i never considered taking this path.
	Terminology & Roles	17. Got tired of having to always explain to companies that I wasnt a fashin designer. / The general line of study at uni felt too undefined and uncertain. I could take all the same courses but feel more "respected" for potential workplaces with another master. / A student job took me from design to ERP implementations

5.7.8 Qualitative Coding: role-designer

In this example, **Begginers** (edu-level=1, n=150) briefly explain how they see the **role of a designer (**role-designer). The answers were classifies by Axial Coding into four different aspects that drive professional behaviour, and allocated in the following categories:

Code	Quotes (edu-level=1, n=53)
Project-Driven	1. Combining fields, leading the project
	2. the role of a designer is to connect every person of different discipline togeter, to make a good functioning project
	3. To improve products or to invent products wich make life better, easier, simple etc.
	4. a designer combines different workfields to work together to make a project together
	5. a designer is the missing link in group projects with different fields
	6. Is one of the key subject in the chain of product development, I believe that a lot of what concerns in the design of a product comes together in the hands of the designer
	7. The designer invents a concept from a problem and knows generally about problemseeking, developing and business.
	8. the connecting link between the other parts of a company
	9. The mediate all levels of designing (e.g., aesthetics, mechanics, cost) and bring them together in one user centered product

	10. To bring together all stakeholders in a project, to find a design that has the highest value (the amount of people benefitting*the benefit - the amount of people losing something*the losses)
	11. Develope products
	12. A person that manages all the different possibilities in a successful end result
	13. design things
	14. Guiding the process of getting an idea to become real
	15. The role of a designer is to create designs which can be produced. it is important that these designs can be sold. You're a good designer when you can make products which sell and change the society in a good way.
	16. To either solve problems or to make improvements concerning a product/service
	17. Designing
	18. Developing meaningful products
	19. To connect the different aspects and parties that are involved. Also to make sure the design is optimized and meets the requirements
	20. Deliver a solution to a problem
	21. To understand complicated problems, finding solutions for it and explain them to other people so that people from different professions can work togheter to make the solution work.
	22. To search for the best possible solution for all parties involved
	23. To investigate needs and wants and solve them with a product of good technology and aestatics
	24. To solve problems by creating products.
	25. to look over the entire process from idea to user interaction and integrate all relations into the product
	26. Fulfilling wishes on the wisest way
	27. Leading a proces, bringing together others
	28. Lave et produkt der favner bredt
	29. The role of a designer is to research a topic and find out what's necessary and working out that frame to create a solution that satisifies those "requirements" but also creating something new from that.
	30. To come up with good solutions.
	31. To improve products. To be bind the different engineers together in the project work. To focus on the user. UX.
	32. problemsolving
	33. problemsolver
	34. To solve problems
	35. To conceptualize needs in a service or peoduct
	36. To consider everything and colect it in to one objekt
	37. using all of your knowledge to create new solutions
	38. To master the process of gathering information from many sources and use it to synthesize new concepts
	39. For an design engineer: connecting the aesthetic work with the technical and the socio technical aspects
project-driven (cont.)	40. Problem solving
	41. Syntese and comunication
	42. To find solutions
	43. To connect the users needs with the technical opportunities, while making it sustainable.
	44. To understand the problem at hand(it might not be the obvius one), and search for the best solution to the problems making a compromise between all the different factors involved in the production, distrubution, use and discarting of the product. Being a designer means kombining a lot of different aspects, of which you might need a lot of research and help, to a solution where you have arguements for all of you choises.
	45. combining and connecting
	46. To identify the problem. Know which "tools" to use at what problems. Like how to create the best circumstances for an innovative process and know when to use experts.
	47. The designer gets some requirements and criterias to work within
	48. To make smarter design decisions & create a beautiful environment.
	49. A Capable person who is innovative and have a wide expertise.
	50. The role of the designer is to bring out the best outcome in a project and work with it's limitations.
	51. Design stuff
	52. Make things easy to use
	53. Depending on a lot of things, like job, project, the shape of the team. But to create and connect.

Code	Quotes (edu-level=1, n=43)
Creativity-Driven	1. To come up with good ideas that solve a problem
	2. To be creative and help their environment
	3. To come up with new solutions to solve a problem in the design of objects, systems etc.
	4. to use creativity in order to solve problems
	5. To find the balance between practicality and art.
	6. To be able to be creative and to make new products that work.
	7. improving and inventing products for better and easier use
	8. To create new things and combinations of things and improve existing things
	9. Combining the right aspects to create a product that works and that people like.
	10. To create or improve products
	11. making a product that comes together on al aspects
	12. Find ways to make or do things (products/systems etc.) better (more effective, more sustainable, more fun, more interesting etc.)
	13. to express and translate a vision into a product
	14. Coming with different creative solutions
	15. Being concerned about the environment and designing products that are more durable.
	16. Make certain products or systems easier or more fun etc.
	17. to solve problems and improve lifestyles
	18. To create useful and aesthetic objects for society
	19. It is to see patterns and opportunities to make something new or to make something better. To be able to make different groups work together, through visual representation
	20. To be creative and think outside the box
	21. Being creative, thinking out of the box, push people out of the safety-zone
	22. to be creative and emphatic
	23. to create something useful and or beautiful and innovative
	24. To be part of a innovative force, that deals with the discovery or rediscovery of the world
	25. To think of and conceptualize more functional and aestetic solutions to problems.
	26. To create and solve problems
	27. A Big part og a designers role is to be creative. AS a designer its your job to Think of new solutions to a problem.
	28. The main brain, the center of ideas.
	29. To come with ideas, make thinks look good.
	30. To create and invent new technology or to improve/redesign already existing designs
	31. To create solutions to problems, where the solution contain a product and a user
	32. To create an optimal product
	33. To create valuable products
	34. To create and fascilitate solutions
	35. To create useable. valuable designs
	36. To create
	37. To think it all striaght out
	38. to create the best solution in every given problem. especially if it can be done in a aesthetic way.
	39. To create functional products that makes a different
	40. To create/design products for a use
	41. Creating a product or being a part of design process to develop something
	42. Create a good product which solves a problem but with good recquirements
	43. To create new and unexpected things. See things from a new angle. Thinking inside the box.
Code	**Quotes (edu-level=1, n=33)**
Customer-Driven	1. to meet the need of potential customers
	2. Designing products for people to use.
	3. Making life easier.
	4. To design a product or system for future needs of the people
	5. solve everyday problems with products
	6. A designer knows what can be improved and wants to change the problems that people have.
	7. To introduce new ideas and technology in a way that people want to use it
	8. to mediate between different people and have a creative input to create a good product

	9. to improve current products and so improve the way we live.
	10. taking in account the user and the effect of a product to society
	11. Designing innovative products or services that enhance human quality of life and dont have any harmull effects for comming generations.
	12. To combinate all the different aspects that are important for a design and to make it suitable for the users.
	13. The one who connects technology to people.
	14. Creating solutions to yet discovered problems by fulfilling the needs of the user
	15. fulfill the users needs
	16. To design something that makes the lives of people better and in this way contribute something to the world.
	17. To create products that better humanity, enabling us to live happy lives
	18. Making products that people realy want to use or can help them.
	19. To find the right solutions for human needs and problems by communicating with other experts.
	20. To make life easier for some/many people.
	21. Be the connection between consumer (needs) - technology and businesses
	22. To make products that make life easier for people
	23. To make products that benefit the lives of people around the world.
	24. improve peoples lives by making things
	25. To help/motivate/inspire/spark its audience.
	26. To create and stimulate new and improved ideas, services and products to help and improve now a day life.
	27. To create products that are makes a difference for the user's everyday life. To develop innovative solutions that people couldn't imagine before the design process
	28. To make a great end-product for the user.
	29. To design products by thinking of the user.
	30. To solve problems for helping others
	31. Making the users life better and making a product, which works well and looks good.
	32. To create solutions to problems that affects the lives of people, in a way where people will use and implement the solution.
	33. To improve solutions, and make them relevant and good for the user.
Code	**Quotes (edu-level=1, n=18)**
Impact-Driven	1. Shaping the future
	2. Innovating world on a global scale
	3. To shape the future
	4. To positively change and influence the world
	5. Vision
	6. come with new solutions to prevent some big issues, like climat change
	7. improve the world
	8. Create new things to make the world better
	9. to shape the future
	10. MAKE THE WORLD A LITTLE BETTER
	11. The role of a designer is to improve living on Earth by providing products, systems and other things while considering all parties that are relevant.
	12. a designer improves the world around him.
	13. serving society
	14. To make the world a better place
	15. To improve the current situation in society/environment
	16. To create the future
	17. To see the whole picture
	18. To make the world a better place.
Code	**Quotes (edu-level=1, n=3)**
other	1. the spil of the group
	2. A designer can have many roles, depending on the situation a designer have to take on different roles.
	3. to make things tolorabel

6. Study 3 - Social- and Self-perceptions about Designers' Professional Identity

Designers' Professional Identity (DPI) is a social- and self-perceptive construct through which designers are able to identify themselves as professionals. Thus, DPI guides professional development by assigning professionalism, role assumptions, responsibilities, values and behaviour throughout the career. DPI consists of two sets of key elements: Personal Attributes (PA) and Design Skills (DS). This study makes use of semi-structured interviews, in both education and professional environments, to shed light on the differences in perceptions about DPI between professors, design managers and designers. This study compares management and education perspectives to individual designers' perceptions. By evaluating these different perceptions, the chapter provides knowledge about the extent to which professors and design managers influence the development of DPI in designers. Analysis of the interview data shows that both professors and design managers contribute to the development of DPI. Thus, designer self-perception develops as an adaptation to the education and professional environments and their distinct influences.

Keywords: Professional Identity, Psychology of Design, Design Activity, Design Research, Human Factors.

Designer's Professional Identity (DPI) is a construct that allows the designer to self-identify as a professional and as belonging to a professional group. This identification mechanism drives attitudes and behaviour, which are fundamental aspects of professionalism (Cruess et al., 2015; Marquardt et al., 2016). DPI consists of Personal Attributes (PA) and Design Skills (DS) (see Chapter 4). The construction of DPI formally starts during higher education. Consequently, design professors play a pivotal role in the initial development of their students' DPI based on their teaching of the societal norms and expectations they believe a designer should have. This process is reinforced via academic assessments. The outcome of this process is that young designers tend to align their perceptions of the design profession to those of their professors (Trede, 2012a). When the designer enters the job market, the influence of the academic environment decreases and the professor's influence is substituted and/or replaced by peers and managers. The interactions in the professional environment create the context in which identity is negotiated and includes the designer's adaptation to managerial practices, societal norms and organizational culture (Crafford et al., 2015), underpinned by job performance assessments and Key Performance Indicators (KPIs). Designers working in industry become aligned to how design managers conceive the design profession.

Professors' and design managers' perceptions of the design profession may not be aligned and this can affect the transition from education to the professional environment (Bucciarelli & Kuhn, 1997; Dall'Alba, 2009). The transition can be difficult, and the perceptions in the designer's early stage career can influence their professional decision-making, e.g., commitment to the design profession or decision to drop out (Lichtenstein et al., 2009). Little is known about the different perceptions of professors and design managers and the literature does not include work on how much influence they have on the development of DPI. This study investigates the differences in self- and social-perceptions regarding the designer role and the DPI elements, by addressing the following research

questions: *What are the social- and self-perceptions regarding the designer role and the DPI elements? What are the differences in the perceptions of professors, managers and designers?*

To address these questions, we conducted an empirical study, based on semi-structured interviews with professors, design managers and designers. The questions asked about their perceptions and expectations regarding the designer's an the importance of the DPI elements and allocation in New Product Development (NPD) projects. The results of the interview study provide a better understanding of the perceptions of these three groups, regarding their influence on designers' DPI development, and the design profession.

This paper is organized as follows. Section 5.1 provides a literature review and highlights the factors influencing the development of DPI. Section 5.2 presents the research methodology chosen for the semi-structured interviews. Section 5.3 presents the results of the interviews in relation to social- and self-perceptions regarding the designer role and expected characteristics (Section 5.3.1), differences in social- and self-perceptions regarding the importance attributed to DPI elements (Section 5.3.2) and the differences in social- and self-perceptions regarding the allocation of DPI elements in a NPD project (Section 5.3.3). Section 5.4 discusses the implications and limitations of this work and points to directions for further study. Section 5.5 concludes and discusses the role played by both professors and design managers in the development of DPI and how this differs according to designers' self-perceptions and adaptation to context. The findings contribute to the literature on DPI development and adds to our understanding of the development of DPI in relation to influences from the education and professional environments.

6.1 The factors influencing the development of DPI

Professional Identity (PI) is described as the dynamic organization of self- and social-perceptions (Skorikov & Vondracek, 2011), which allows the individual to self-identify as a professional and drives attitudes and behaviour fundamental to professionalism (Cruess et al., 2015; Marquardt et al., 2016). Thus, PI formation involves awareness of what matters in practice and which values and interests shape decision making in design and actions as a design professional (Trede, 2012b). How the individual perceives him or herself as a professional is a reflection of self-awareness (Crossley & Vivekananda-Schmidt, 2009) and usually is based on the expectations about an ideal model of a designer, which are seen as a goal to be achieved (Godsey, 2011; van Knippenberg et al., 2004). Professional consciousness plays an important role in confidence and professional development (Skorikov & Vondracek, 2011). The development of PI is directly related to professional development and experience and is recognized through rewards and acknowledgments and a career marked by promotions, honours and distinction (Baumeister & Muraven, 1996). This inspirational stereotype guides the development of a self-understanding and the sense of belonging to a professional group (Haslam & Ellemers, 2011). This sense of group belonging is integral to the self and determines professional satisfaction, improved competence and performance in the work environment (Ashcraft 2013).

Research shows that the social context in which someone operates affects the formation of DPI (Gomes & Teixeira, 2000; Godsey, 2011; van Knippenberg et al., 2004), since interactions between individuals contribute to the development of a range of self-understandings on which the individual draws to constructing PI (Williams, 2013). Moreover, at different career stages, self-perception and

PI change and adapt (Dent & Whitehead, 2001). During education, skills acquisition is directed by academic rubrics and evolves towards an expected set of elements established by the university's curriculum and approach to design. At this career stage, professors set out the norms and their expectations for a designer and reinforce these via academic assessments. Consequently, in the early stage design career, professors influence and shape the designer's DPI. Dym et al. (2005) discuss some of the issues related to teaching design engineering to produce professionals able to tackle real problems. Young professionals tend to align their perceptions to those of their professors and the education they received, which influences their expectations.

DPI is a continuously evolving, lifelong process. In the professional environment, the professor's role passes to the design manager and social practices create the context for negotiating identity. These social practices include adaptation to managerial practices and the organizational culture (Crafford et al., 2015). Also, in the work environment, the reactions of others shape the evolution of PI by validating (or not) new behaviours and providing feedback to allow improvement (Ibarra, 1999, p. 12). The design manager sets the norms and expectations related to being a designer and reinforces them in employee performance assessments. Sun (2011) identifies the design manager as mainly responsible for the designer's and the design team's activities to ensure successful daily design work. Thus, over time, professionals tend to align their perceptions to managerial aspects (Brunhaver et al., 2011), imitating their role models to achieve successful adaptation to the work environment (Ibarra, 1999). The main influence in the transition from professor to design manager is one of the focuses of the present study.

The designer's self-perception adapts to environment transitions. Thus, the professional environment and work activity shape the actions and practices expected of the professional (d'Anjou, 2011). Adaptation to achieve alignment to social-perceptions and common professional beliefs is based on achieving professional advancement and recognition (Baumeister & Muraven, 1996). Understanding the different perceptions in different environments helps to explain how DPI is constructed. It highlights the gap between students' expectations based on university design programme requirements, and what employers demand (Wells et al., 2009). The main components of DPI are reflected in the perception of PA and DS and their alignment to internal and external expectations (see Chapter 4) (Haslam & Ellemers, 2011). However, in each specific context, e.g., education or work environment, the characteristics expected of a 'good designer' will vary.

The transition from education to the profession, requires fundamental changes to individual self-perception and self-identification as a designer. Consequently , it requires new skills, behaviours, attitudes and patterns of interactions to facilitate a better fit and negotiation with the new environment (Ibarra, 1999). In other words, adaptation is needed to resolve the discrepancies between the perceived 'ideal designer' and the current DPI. Similarly, understanding of the professional role and the feeling of belonging to a professional group can be undermined by divergence between self-perception and expectations in a particular environment. The transition from student to design professional is shaped by the education and work environments. Despite the contribution to DPI made by professors and design managers, their understandings of design may not be aligned. We try to identify these differences in social-perceptions and compare them to the individual designer's own perceptions and contextual self-identification.

6.2 Methodology

To evaluate the differences in social- and self-perceptions about the role and abilities comprising DPI, semi-structured interviews were held with professors, design managers and designers. Differences between the groups are expected to contribute to designers' self-perception with aspects from both academy and practice. The interviews aimed to address the following research questions:

> *RQ1) How does perception of DPI vary between designers, design managers and professors regarding the designer role and expected characteristics?*
>
> *RQ2) How does the importance of importance of DPI elements differ between designers, design managers and professors in terms of?*
>
> *RQ3) How do the perceptions of designers, design managers and professors differ regarding the allocation of DPI elements in a NPD project?*

To assess the perceptions and attributions of professors, design managers and design engineers (designers) differ, this study uses the two sets of DPI elements described in the literature as PA and DS (see Chapter 4). Both PA and DS suggest elements that explicitly contribute to the design process and are recognized as characteristics required by the designer and acquired with design expertise. Table 17 presents these elements and the coding system used in this study. Table 18 presents the DPI elements based on their descriptions in the literature.

Table 17. Categories and coding for DPI elements

DPI category	Code	Name
PA	ET	Ethics
PA	CR	Creativity
PA	OP	Openness
PA	EM	Emotion
PA	EP	Empathy
PA	SA	Social Abilities
PA	LE	Leadership
PA	RE	Responsibility
PA	MO	Motivation
PA	CO	Confidence in the work
PA	SC	Self-Confidence

DPI category	Code	Name
DS	CA	Cognitive Abilities
DS	CS	Cognitive Strategies
DS	PC	Personal Communication
DS	IC	Interpersonal Communication
DS	EK	Knowledge from Education
DS	PK	Knowledge from Practice
DS	MC	Manager competency
DS	PM	Project Management

Table 18. Relation of DPI elements to design process

DPI element		Description on literature
PA	Ethics	Professional understanding and taking responsibility for project outcomes, and how design solutions impact users and society (Cañavate et al. 2015)
PA	Creativity	Individual competency that can have a significant effect on the quality of a design solution (Kim et al., 2011)
PA	Openness	Open-mindedness and the capacity to deal with uncertainty or ambiguity (Ball & Ormerod, 2000; Cross, 2004), as well as in terms of flexibility (Brunello & Schlotter, 2011).
PA	Emotion	an 'affect' based on background experiences, and a 'feeling' based on an awareness and knowledge of the affect (Tomkins, 2008). The affective state comes from a reflection on the situations encountered within designed work (Dong, 2009).
PA	Empathy	usually discussed towards the user (user-centred design) and targeting the audience (Koskinen et al., 2003). Studies on user-centred design discuss empathy as an important part of a design process, which can be influenced by individual ability and the willingness of the designer (Kouprie & Visser, 2009).

PA	Social abilities	Fundamental behaviour to design. Some authors even describe design as essentially a "social ability" (Alexiou et al., 2009) i.e., a "social process" more than a cognitive process, while taking into consideration that it is done by persons situated within a rich and dynamic social context and is not a mechanical process (Ball & Ormerod, 2000a; Bucciarelli, 1988).
PA	Leadership	Refers to two main categories: task-focused i.e., those dealing with task accomplishment, and person-focused i.e., facilitation of team interaction and/or development (Burke et al., 2006).
PA	Responsibility	the sense of personal responsibility for outcomes, which is more than a required qualification for industrial design work (Yang et al., 2005), it is also the designer's capacity to work within own beliefs.
PA	Motivation	one of the most critical attributes for designers, directly impacting performance (Robinson et al., 2005).
PA	Confidence	a certainty in own abilities (self-confidence) or in own professional skills (professional confidence) (Shanteau, 1988; Tracey & Hutchinson, 2015)
DS	Cognitive abilities	Understanding the design problem (e.g., Lawson, 2005), 'designerly thinking' (e.g., Cross, 1982; Oxman, 1999), capacity for abstraction (e.g., Oxman, 1990), and evaluation through analysis (e.g., Khorshidi et al., 2016)
DS	Cognitive strategies	Learning through design (Elkjaer & Brandi, 2014; Garner, 2005), problem framing (Cardoso et al., 2016; Cross, 2004), development of a problem solution (Fiorineschi et al., 2016; Kruger & Cross, 2006), and problem solving (Atuahene-gima, 2011; von der Weth, 1999).
DS	Personal communication	The capacity to communicate clearly and directly, attendance to details, and empathy with an audience (Robinson et al., 2005).
DS	Interpersonal communication	The capacity to make public presentations, provide proper documentation of the work process, set collaborations, and to communicate among a team establishing rapport (Crain et al., 1995; Sonnenwald, 1996).
DS	Education-based knowledge	Language competency in design (Bucciarelli, 2002; Dong, 2009), basic knowledge in design (McLaren & Stables, 2008; Wilpert, 2007), and focused knowledge in the working area (Krawczyk & Murphy, 2012; Seitamaa-Hakkarainen & Hakkarainen, 2001).
DS	Practice-based knowledge	Negotiation capacity, imagination/representation quality and speed, IT competencies, and knowledge appliance ability (Yang et al., 2005).
DS	Managerial competency	Managerial competency of generic tasks i.e., personal organization and time management, and a managerial competency for job-related tasks i.e., accomplishment of deadlines and project milestones (Vaishya et al., 2016).
DS	Project management	Project planning, project development, and effectiveness assessment (Coates et al., 2004; Mir & Pinnington, 2014). The ability to plan a project stresses a basic structure in design work (Yang et al., 2005) , especially important in consultancy (Hakatie & Ryynänen, 2007), through which the client's views and the designer decisions are aligned to produce satisfactory outcomes for both of parties (Lewis & Bonollo, 2002).

6.2.1 Sample

Thirty-five semi-structured interviews were conducted: design professors (N=16, 2 to 20 years of experience), design managers (N=9, 2 to 25 years of experience) and professional designers (N=10, 2 to 15 years of experience). All the subjects were permanent residents of Denmark and had connections to the Design & Innovation programme offered at the Technical University of Denmark. The design professors were lecturers in formal design engineering education in the Design & Innovation programme. The design managers and design engineers were drawn from nine companies, where designers and managers were part of the same team. All were responsible for at least three designers. The design managers and designers together represent a range of large and small companies covering design consultancy and product development.

6.2.2 Data Collection

To measure DPI perception among the three groups, three main interview techniques were used: (1) open-ended questions; (2) closed questions; and (3) concept mapping. This multi-method approach was used to address RQs and the complexity and multidimensional nature of perception (Kraiger & Wenzel, 1997). The interviews allowed respondents to describe and share their perceptions before being asked about DPI constructs and terminologies. A "thinking aloud" process provided qualitative background for the second and third steps of the interview guide. This combination of multiple measures included:

a) Open-ended questions (see Appendix 3, section 6.7.1 for the interview guide) which allowed the respondents to reflect on the role and main characteristics of a designer. The interview guide was used for all the interviews. However, not all the questions were posed to all respondents; in some cases, their reflection produced diverging answers. A comparison of the responses from the three groups addresses RQ1.

b) A short questionnaire (see Appendix 3, section 6.7.2) asking respondents to attribute importance to sentences describing design work activities and design knowledge, which were correlated to DPI elements. A comparison of the responses from the three groups addresses RQ2.

c) Concept mapping of the allocation of DPI elements in a generic NPD project process (see Appendix 3, section 6.7.5 for an example.). This involved the respondents allocating DPI elements (from a list provided) within a generic NPD project timeline. The respondents were free to use any resource available to explain their points of view (including drawing and repetition of the elements along the process). Respondents were asked which characteristics they believed were required or not for a designer working on a NPD project. This mapping resulted in concept maps of the perceptions of each group of respondents; comparison of the maps responds to RQ3.

6.2.3 Data analysis

The 35 semi-structured interviews were transcribed and analysed qualitatively. Transcription of the responses to the open-ended questions was accomplished using Dragon software and the transcriptions were evaluated individually and corrected manually when necessary. An example of the coding schemes and analysis is presented in Appendix 3 (section 6.7.7) based on a random selection of five (N=5) respondents per group. Thematic analysis of the transcribed responses identified the major themes regarding the designer role and competencies, across all three groups of respondents.

Data analysis of the questionnaire responses and concept mapping uses the data collected from all 35 interviews. Descriptive statistics (see Appendix 3, section 6.7.4) were derived from the survey items (see Appendix 3, section 6.7.2) and evaluated as category bundles (see Appendix 3, section 6.7.3). If the professional designer's main activity is in NPD, they are allocated to a NPD task of NPD implementation. Following Ulrich and Eppinger (2016), we proposed a generic NPD project, consisting of the following five phases: definition, ideation, development, validation and product delivery or launch. The respondents were asked to allocate DPI elements to project phases, based on the importance of each element in the specific phase. Evaluation of the results for all three groups produced a network of DPI element allocation over the project phases, based on more than 50% of

the respondents coinciding in the allocation of PA and DS to each project phase. The data analysis is based on the quantification of the responses and descriptive statistics. The differences in perceptions among the groups are reflected also in the allocation of the elements comprising PA and DS in a project. Comparison among the groups provides an understanding of the behaviour expected of a designer during a project, based on the self-perceptions of the designers, professors and design managers. The differences in the expected behaviours of a designer in each phase of the project, allows practical reflection on the group's vision regarding the designer role and the importance of DPI elements.

Analysis of the concept maps uses shared mental models techniques (Neumann, 2012). Concept maps are representations of the relations that people perceive among elements, in this case, the relations between the DPI items and the phases of the NPD process. Thus, the mapping of the allocation of DPI elements in the NPD process was analysed (see Appendix 3, section 6.7.4). There are three main indicators that determine how much the concept maps produced by the different groups , are aligned. These indicators are sharedness, accuracy and importance of a mental model. We applied all three in this study. Sharedness takes account of concepts that are both *shared among* (i.e., overlapping or identical) and *shared between* (i.e., complementary) (Klimoski & Mohammed, 1994). Accuracy is closely related to sharedness; accurate concept maps tend to be shared among the group (Badke-schaub et al., 2016). Importance can be assessed on two levels: attributed importance (taking account of the questionnaire) and centrality (based on the number of the network connections) (Badke-schaub et al., 2016).

6.3 Results

The building blocks for the analyses followed the structure used for the data collection: i) *Social- and self-perceptions regarding the designer role and expected characteristics* (RQ1), which is related to the mind-set of the group regarding the designer's role; ii) *Differences in social- and self-perception regarding importance attributed to DPI elements* (RQ2), based on the importance attributed and the analysis of significance of each respondent; and iii) *Differences in social- and self-perceptions regarding the allocation of DPI elements in a NPD project* (RQ3), based on the network connections between the DPI categories and the project phases.

Thematic analysis of the transcribed responses identified the major themes regarding the designer's role and competencies, for all three groups of respondents. These are (1) *Technique*, (2) *Creativity*, and (3) *Rapport,* labels that expressed the desired meanings. The theme *Technique* includes sentences whose meaning refers to designer practice, DS, methods or technical abilities. *Creativity* includes sentences whose meaning refers to designers' brilliance, mind-set, creativity, intentions or multidisciplinary capacity. The theme *Rapport* includes sentences whose meaning refers to designers' empathy, communication, collaboration or interaction abilities. Appendix 3 (section 6.7.7) provides more detail. These themes and the different perception regarding DPI elements are discussed in the corresponding sections. The results are analysed in terms of group perceptions – to allow an overall perspective from each group, and shared perceptions – where social-perceptions are compared to the self-perceptions from the designer group.

6.3.1 Social- and self-perceptions regarding designer's role and expected characteristics

The results of the thematic analysis of the responses to the open-ended questions highlights three main themes: *Creativity (C)*, *Technique (T)*, and *Rapport (R)*. The transcriptions provided in Appendix 3 (section 6.7.7) include the sentences where each respondent explained his or her perceptions related to one or more of these themes. The number of responses per question is the total for each theme and determines its importance for the group. Table 19 presents the number of quotes to each question based on the themes.

Table 19. Number of interviewees mentioning the identifies aspects of each theme

	Designers			Design Managers			Professors		
Themes / ***Questions***	***C***	***T***	***R***	***C***	***T***	***R***	***C***	***T***	***R***
Role of the Designer	3	3	1	1	3	3	4	3	0
Impact on society	1	2	1	3	1	1	4	0	2
Values at work	1	3	2	1	3	4	4	2	0
Most important Characteristics	3	4	1	3	5	5	4	2	3
IDEAL	2	2	2	5	3	3	4	3	3
INSPIRING	4	3	1	4	2	4	5	3	0
Undesirable characteristics	1	2	3	4	1	3	3	2	1
Balance between PA and DS	3	1	0	3	5	2	4	2	2
TOTAL per Theme	18	20★	11	24	23	**25★**	**32★**	17	11

Although the respondents in all of the groups identified aspects related to all three themes, each had a distinct view of the designer's role. First, the designers tended to emphasize aspects related to *Technique* in their professional role and characteristics, and saw themselves as practical-oriented and as creative "doers". They saw their role mainly as to bring an idea from concept to production – making use of their knowledge and methodologies. Thus, this group saw their role as *"being able to make radical changes to an already available product and see one's design being brought into the production, to bring it to the next level*" (D5). Most of the respondents saw their main role as ability to make use of methods and to manage projects in order to deliver "*something practical and meaningful"* (D2). However, they believed also: *"I think the designer is not only a problem solver. The role of a designer is to come up with unexpected things*" (D1), but none of the participants attributed this characteristic to their actual role in the company. Firms expect their designers to be realistic since *"in our company […] we decide products for our clients. That's almost all what we do"* (D3). In addition, in terms of efficacy, they have *"to be able to handle the whole project, from idea to making it come true"* (D5). Thus, designers have to do more than solve the problem; they must be able to make use of methods and carry the process to its end while adding value by applying their technical capabilities to satisfying user needs. Idiosyncratic responses highlighted the role of the designer at two extremes, as a visionary or as a method implementer. Among these perceptions, the designer "*is to be visionary, because within an organization they will always be people who are working on the incremental efficiency of the product — to increase the performance of the product or make production easier — or satisfy the needs of the user incrementally"* (D5). However, at the same time, the

professional role relies on a structured way of thinking, i.e., *"for me, it's a way of thinking, a method. The way that I perceive a task from when I get it to how to solve it"* (D4).

Second, design managers tended to emphasize aspects related to *Rapport* and had a view of the designer in terms of satisfying clients. They saw the role of the designer as acting as a bridge between the company and its clients, i.e., to *"find out what is good for the company and for the customer"* (M3) and then implementing the technical aspects in a solution. They felt the designer should *"help to develop visions among our clients, of how they can perform better with whatever they are doing and then translate it into some kind of engineering work, some technical stuff"* (M2). At the same time, as professionals, designers should be able to create novelty and make fast decisions based on their knowledge. *"One of the fundamental things is that they have the right background, that they know their skills, and they can take some decisions based in what they know"* (M1). None of the design managers attributed radical changes or unexpected solutions to the role of a designer in a company. Design managers consider that the designer has to solve the client's problem and facilitate the process effectively based on their knowledge: *"you have a responsibility as a designer to try to make things better not only for you but also for other people"* (M5). Thus, *"you have to be good at your professional skills, but it is also very important that you are able to listen to the others in the group and interact with them, and understand their [the clients'] problems and find the best solution"* (M1). The relation between technical ability and precise communication, empathically addressing the client's needs, are reflected in positive outcomes according to the design managers, i.e., *"If I can show the path to the new concept in a logical and convincing way, then I have the customers' right where I want them and I probably also have a very good product"* (M4). Individual responses focused also on performance and the work environment, whether the role of the designer is to cooperate with the team, on being efficient and autonomous. For example, as a designer *"you have to be good at your skills, but is more important that you are good at cooperating, can do your job quickly and you are dynamic - when things go wrong we have to find a solution very quickly. Being a good team player helps everyone proactively*" (M1). In this case, design managers saw the designer's role as more than finding solutions to clients' problems; they saw it as important not to create problems at work and to be able efficiently to manage the project.

Finally, the professors generally emphasized aspects related to *Creativity*, and a view of the designer as a creative thinker who is innovative. They considered that designers should be able to *think designerly*, i.e., have a design mind-set, ability to question the situation and challenge the status quo creatively, and take an idea from concept to embodiment, based on their skills and knowledge. This requires the designer to have the ability to work in a multidisciplinary setting. As explained by the professors, *"the designer is someone who bridges all these disciplines and brings all this together"* (P2), thus *"their role is to put different elements together in order to standardize the creation, the creative process"* (P4). All the professors concluded that their main focus when teaching was not just to provide the basic technical knowledge but to create a questioning and creative thinking mindset. "*I think the mind-set is what creates the designer […] I am very aware, when I plan my classes that this lecture is about creating a mind-set…"* (P1). In this sense, the professors also attributed making radical changes or finding unexpected solutions as fundamental to the designer's role. Designers have to pursue knowledge, skills, and attitudes towards creating new solutions and providing changes. *"Designers are, in my eyes, change agents. They create the surrounding around us and for that they need to be agile [mentally]"* (P3). In this sense, professors perceived designers as contributing to society

"by improving the environment at all stages, in production, the working environment, the production environment, the use of resources, uses of water and energy and so on. And then the way their product impacts during use and during recycling and end of life" (P5).

Hence, perceptions regarding the designer's role and identity diverged between the groups. These differences express particular perceptions regarding the designer's professional role and expected characteristics in each context, i.e., the education environment and the work environment. Differences concerning social attributions and characteristics were expressed in relation to the *Creativity* and *Rapport* themes. At the same time, designers' self-perception and expectations emphasized the need for a technically reliable outcome at the end of the project, and stressed design through *Technique*. These differences in perceptions between professors and design managers contribute to shaping DPI as adaptation embracing different values and beliefs, and the different influence of each group in the separate stages of the designer career. These differences are reflected also in how each group ranked the elements of an ideal designer, and their importance at different stages in the project, as described below.

6.3.2 Differences in social- and self-perception regarding attributions of importance for DPI elements

Perception of DPI relies on understanding the designer as a professional based on his or her role and position. Thus, the attribution of cognitive and behavioural characteristics, such as PA and DS, was analysed quantitatively in relation to perception as a good designer. A few elements identified were not included in the list of either PA or DS. These elements are included in the descriptions below, were not included in the quantitative analysis (Figure 8), which considers only the DPI elements in the original framework.

Designers' perceptions of DPI elements referred to what were considered the most important. Designers indicated DS such as 'knowledge from education' (+EK) and 'knowledge gained through om practice' (+PK), 'cognitive abilities' (+CA) and 'cognitive strategies' (+CS), 'representation and communication of ideas' (+PC), and 'project management abilities' (+PM).

Characteristics regarded as impeding the designer DPI were also identified in relation to elements of DS such as 'lack of knowledge from education' (-EK) and 'lack of practical knowledge' (-PK), 'biased cognitive abilities' (-CA), and 'bad project management' (-PM). Negative aspects of PA elements such as 'lack of motivation' (-MO) and 'lack of social abilities' (-SA) were highlighted as *critical* for being a successful designer. All of these elements relate to the theme *Technique* discussed in Section 6.3.1.

Design managers focused on elements that promote and facilitate socialization such as 'social abilities' (+SA), 'empathy' (+EP), 'openness' (+OP), and 'interpersonal communication' (+IC). Moreover, they emphasized 'cognitive abilities' (+CA) and 'cognitive strategies' (+CS), 'knowledge from education' (+EK), 'manager competency' (+MC), 'creativity' (+CR), 'motivation' (+MO), and 'emotions' (+EM).

Characteristics that design managers considered bad for a designer are about: 'being emotionally unstable' (-EM), 'overconfidence or not flexible' (-SC), 'lack of responsibility' (-RE) or 'knowledge' (-EK), 'not being sociable' (-SA) or 'not independent' (-PC), 'disrupting work environment' (*not listed*),

or 'not addressing the client's need' (*not listed*). All of these elements are related to the theme *Rapport* described in section 6.3.1.

The design professors focused on PA elements along with knowledge from education. The main characteristics they identified focused on 'Motivation' (+MO) in terms of 'being curious' (*not listed*) and 'persistent' (*not listed*) – 'keep asking questions' (*not listed*), 'Responsibility' (+RE) in terms of determination and perseverance – keep on going and trying, 'Emotions' (+EM) in terms of being stable and resilient to failure – seeing failure as learning, 'Empathy' (+EP) and 'Confidence' (+CO) in terms of being humble and curious about people – listening and understanding the context, and 'Creativity' (+CR) and 'Openness' (+OP) in terms of discovering new approaches and solutions – *dig down into unexpected new areas*. The characteristics considered by professors to be negative for a designer, include with 'overconfidence' (-SC), 'not flexible', 'lack of designer mind-set' (-CA), 'not learning from failure' (*not listed*), 'lack of knowledge' (-EK) and 'inability to follow the process' (-MC). All of these elements are related to the theme *Creativity* described in section 6.3.1

The differences in perception were also evaluated based on the attribution of importance (Likert scale) to each item in the questionnaire, i.e., sentences regarding design work activities and design knowledge. The differences fall into three general clusters: a) design managers and professors provide contrasting views and both differ substantially from the views of designers; b) managers and professors tend to agree, but their views differ substantially from those of designers ; and c) either professors or managers agree with designers and only one group is different from the other two. These three clusters are depicted in Figure 8 together with the Likert-based comparative results. The DPI elements were expressed as combinations of items from the survey (see Appendix 3, section 6.7.3). Figure 8 shows the different importance attributed to each DPI element using the designers' views as the bottom-line. Details of the descriptive statistics, the differences and t-test scores are provided in Appendix 3 (section 6.7.4).

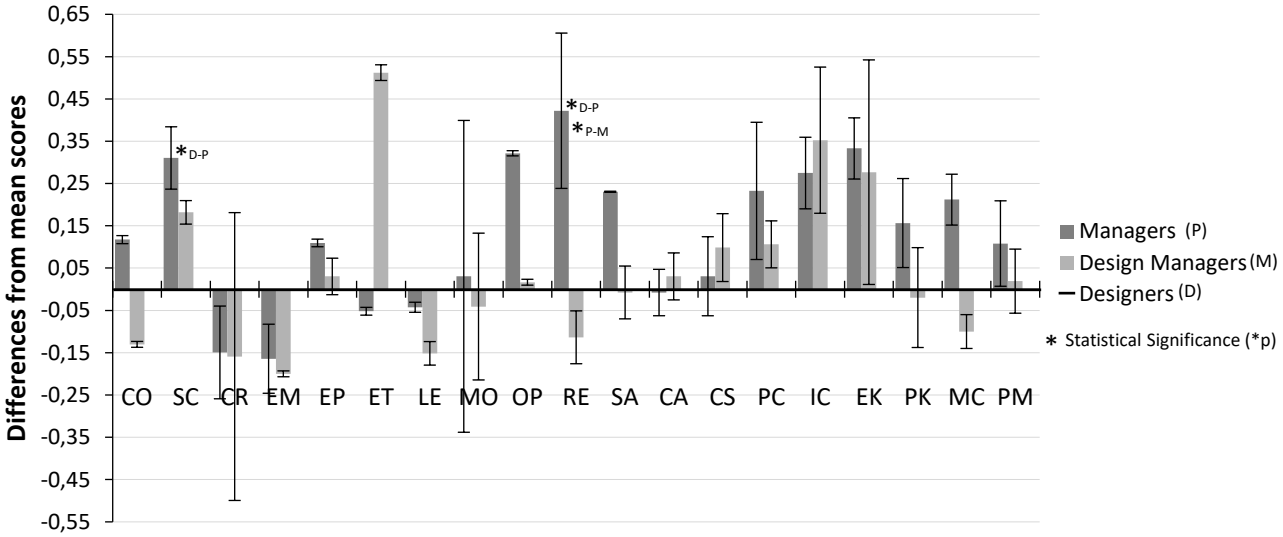


Figure 8. Differences in self and social attributions of importance for DPI elements

The first cluster includes Confidence (CO), Ethics (ET), Responsibility (RE) and Managerial Competencies (MC). Mangers prioritized RE compared to designers (-0.11), while professors considered it less important (0.42 *p=0.04). The two groups are significantly different from each other (-0.54 *p=0.03). Similarly, CO (P=0.12; M=-0.13; P-M=-0.25), and MC (P=0.21; M=-0.10; P-M=-0.31), all display differences in opposite directions with design managers attributing more importance to these elements than the designers and the professors attributing less. For ET the professors attribute slightly more importance than designers do while the design managers consider ET to be much less important (P=-0.05; M=0.51; P-M=0.56).

In the second cluster, professors and design managers attribute more importance than designers to Creativity (CR), Emotions (EM) and Leadership (LE). However, designers attribute more importance than professors and design managers to Self-Confidence (SC), Empathy (EP), Personal Communication (PC), Interpersonal Communication (IC) and Knowledge from Education (EK).The designers prioritized SC compared to both design managers (0.18) and professors (0.31 *p=0.05), while the professors differ significantly from designers, but are similar to design managers (-0.13). Similarly, EP (P=0.11; M=0.03; P-M=-0.08), Cognitive Strategies (CS) (P=0.10; M=0.11; P-M=-0.01), PC (P=0.23; M=0.11; P-M=-0.13), IC (P=0.27; M=0.35; P-M=0.08) and EK (P=0.33; M=0.28; P-M=-0.06) all display differences with where professors and design managers displaying similar trends.

In the third cluster, designers and design managers share their perceptions for Openness (OP) (P=0.32; M=0.02; P-M=-0.30), Social Abilities (SA) (P=0.23; M=-0.01; P-M=-0.24), Knowledge from Practice (PK) (P=0.16; M=-0.02; P-M=-0.18), and Project Management (PM) (P=0.11; M=-0.02; P-M=-0.09) while professors attribute less importance to these elements. The results for Motivation (MO) (P=0.03; M=-0.04; P-M=-0.07) and Cognitive Abilities (CA) (P=-0.01; M=0.03; P-M=0.04) are inconclusive.

On average, the designers seems more moderate about the importance of DPI elements when compared to Professors and Managers. These different priorities are summarized in the ranking of the DPI elements derived means for each group. This confirms the critical importance of each groups' visions and approaches as differentiating the groups. Figure 9 depicts the differences in group attributions based on rankings. The rank calculations for the response means are provided in Appendix 3 (section 6.7.8).

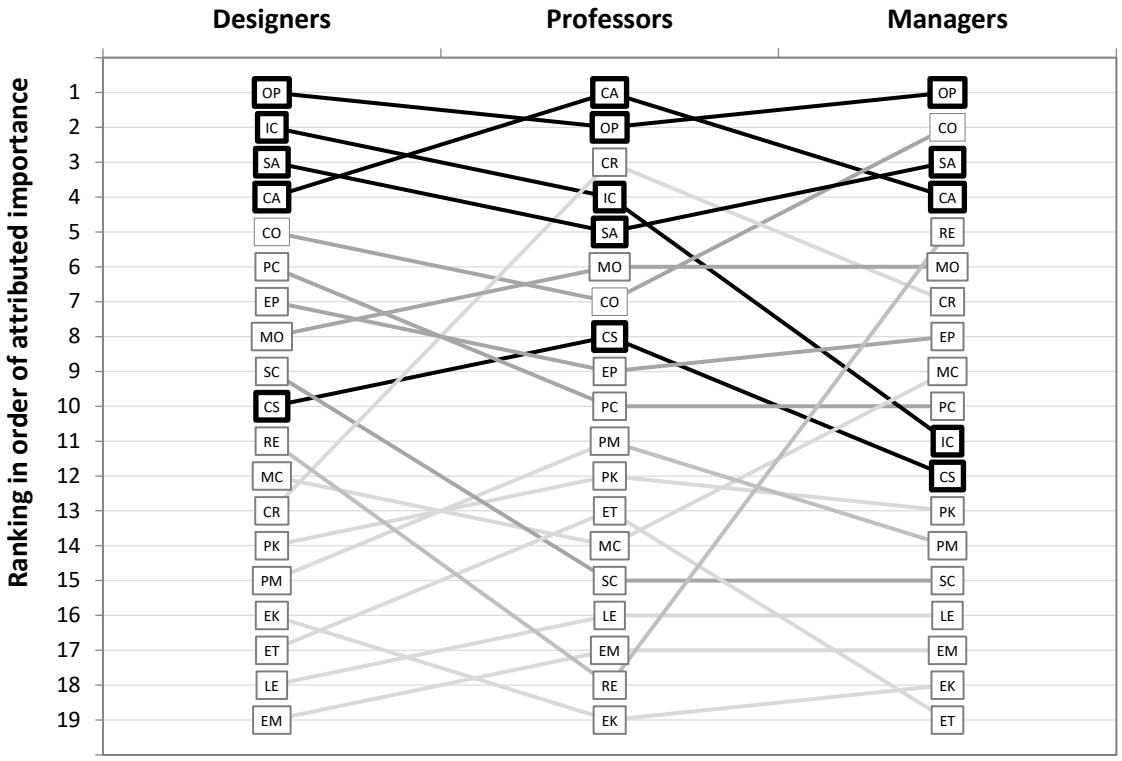
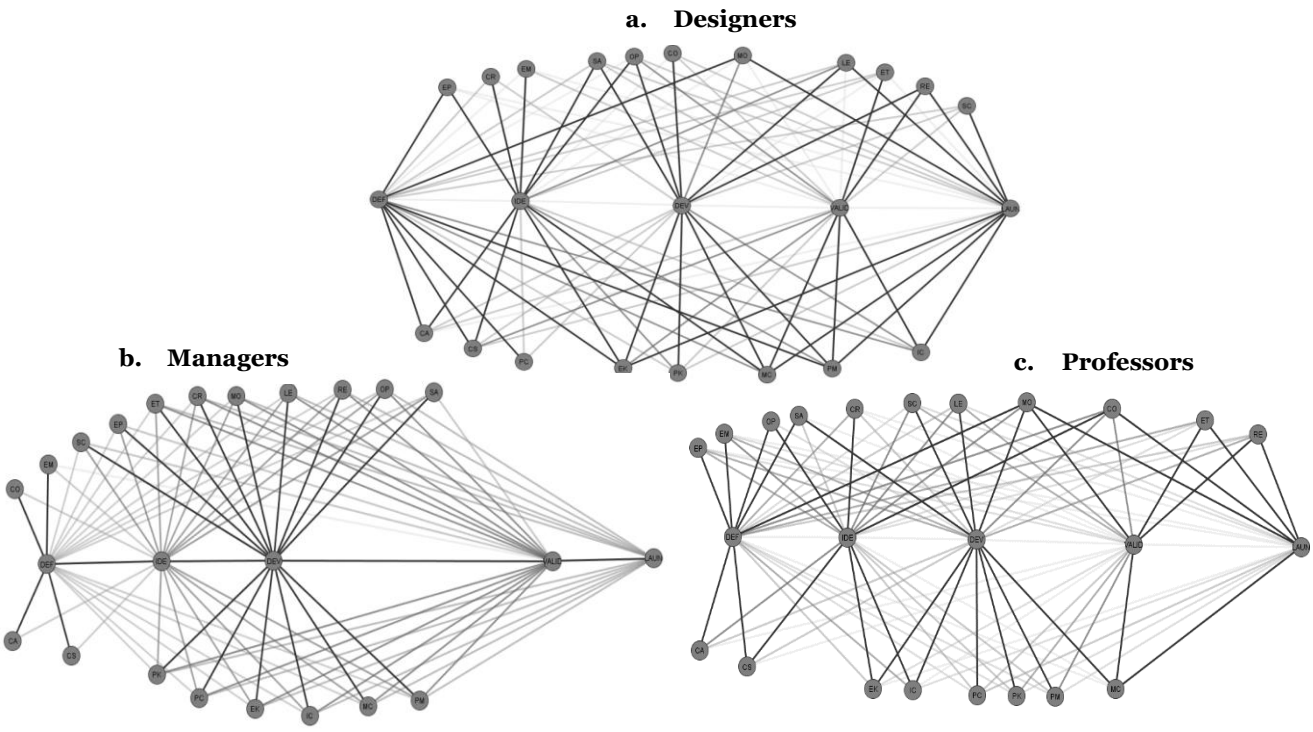


Figure 9. Comparison of DPI elements' rankings based on mean scores for importance attributed by each group

6.3.3 Differences in social- and self-perceptions regarding the allocation of DPI elements in a NPD project

In relation to the NPD project, the three groups again show a number of substantial differences based the concept maps they created, which are depicted in Figure 10. Although Figure 10a-c depict the allocation of each element, each of the groups emphasized a more limited subset as important for each stage in the project, as described below. A complete table of expressed sharedness (%) among the respondents is provided in Appendix 3 (section 6.7.6).

In general, it was designers who indicated a need for most of the elements across all project phases, as shown by the balanced network depicted in Figure 10a. This 'whole project' view demonstrates the thematic focus of designers as practically-oriented creative doers, responsible for developing the design from the start of the project to production. Designers showed an evolutionary prioritization of the elements as the project progressed. In the early stages Cognitive Abilities/Strategies, Empathy, and Creativity were considered important, while in the middle phases of the project Confidence and Leadership were seen as more of a priority, , and at the end of the project Managerial Competency and Interpersonal Communication were found to matter more.



		Definition	Ideation	Development	Validation	Delivery
a. Designers	PA	EP (57%) MO (57%)	CR (100%) EP (71%) OP (71%)	CO (100%) LE (71%) OP (57%)	ET (43%) RE (43%) OP (43%)	RE (57%) LE (43%) MO (43%) SC (43%)
	DS	CS (86%) PM (86%) CA (71%) PC (71%)	CS (86%) EK (71%) CA (71%)	EK (86%) MC (86%) PM (71%)	PM (86%) MC (57%) IC (57%)	IC (43%) EK (43%) MC (43%) PC (43%)
b. Design Managers	PA	CO (75%) CR (75%) EP (75%) MO (75%) SA (75%)	CR (75%) EM (75%) EP (50%) LE (50%) SA (50%)	RE (75%) CR (50%) LE (50%) MO (50%) SA (50%)	SC (50%) ET (50%) MO (50%) RE (50%) SA (50%)	-
	DS	CS (75%) EK (75%) MC (75%)	IC (75%) PK (75%) MC (75%) PM (75%)	IC (75%) PK (75%) MC (75%) PM (75%)	MC (75%) PM (75%) PC (50%) IC (50%) PK (50%)	PK (50%) MC (50%)
c. Professors	PA	EM (70%) EP (70%) OP (70%) CR (100%)	OP (80%) CO (60%) LE (70%) SC (60%)	MO (60%) RE (80%) MO (60%)	ET (50%) CO (50%) CO (40%)	ET (40%) MO (40%) RE (40%)
	DS	CA (80%) CS (70%) IC (40%)	CS (80%) CA (50%) IC (50%) EK (50%)	MC (90%) PM (90%) PK (60%)	MC (70%) PM (50%) PK (40%)	MC (40%)

Figure 10. Allocation of DPI elements across an NPD project and perception sharedness (% of respondents agreeing with allocation)

Generally, the design managers emphasized Managerial Competency and Social Abilities as important during the whole project. This is linked to their pragmatic view of the designer as the interface between client and firm. However, design managers focused mainly on the central phases of the project as shown in the network depicted in Figure 10b. Thus, in the managers view, during validation, self-confidence and ethics (towards users) are important for the problem-solving process and delivery is mainly an administrative task that does not require any specific designer attributes.

Generally, the professors' distribution of DPI elements was fairly balanced. In the early project phases, the professors highlighted the need for the majority of the DPI elements rather than across all the project phases, as shown in the network depicted in Figure 10c. This is linked to their view of the designer as a creative thinker who promotes innovation. They highlighted prioritization of Creativity and Knowledge from Education during the ideation phase. Confidence was considered important at the end of the ideation phase, to kick-start a healthy development phase. Although the professors referred to some elements related to the later project phases, their main focus was on the early phases where there are the most opportunities for changes in the project concept. Similar to what was depicted in Figure 8, the three groups differed in the priority given to different project stages.

6.4 Discussion

This study set out to understand the differences in self- and social-perceptions regarding the designer's role and the DPI elements. We investigated social- and self-perceptions regarding the designer's role and expected characteristics (RQ1), differences in social- and self-perception regarding the importance attributed to DPI elements (RQ2), and the differences in social- and self-perceptions regarding the allocation of DPI elements in a NPD project (RQ3). The findings that emerged from the combination of research methods used for this study, highlight the differences in the self- and social-perceptions of the three groups. Professors and design managers represent the social-perception while designers represent the self-perception evaluation.

The results for DPI perception diverge among the groups and the differences in perceptions are related to distinct understandings. Based on the thematic analysis of the results, we identified three attribution trends in relation to the designer's role and abilities, across all the respondent groups. These three themes are: *Creativity*, *Rapport* and *Technique*, with each group identifying most strongly to one of these themes. Based on the RQs, the different perspectives of the groups can be described as *practice-oriented*, *client-oriented* and *contribution-oriented*.

In all cases, the role of the designer as a problem-solver was linked to the *practice-oriented* approach under the theme *Technique* (Chapter 6, section 6.3.1). A practice-oriented approach indicates a focus on seeing the project as a process, from idea to production and delivery. The self-perception of the designers highlights a *practice-oriented approach,* in which creativity and capacity are required to find radical solutions, and the focus is on a successful outcome (product or service) at the end of the process. Overall, designers see their role as involving exploitation of their knowledge, ability to manage the project through *all* its phases and fulfilment of user/client needs. This view of the design profession is aligned to one of the five types of individual learning path proposed in Poell & Van Der Krogt (2014), where the focus is primarily on improving the every-day work process. By adapting the knowledge gained from formal education to professional work practice, and by experimenting

with behaviours to achieve success, designers need to make dynamic amendments to their professional identities (Ibarra, 1999). In relation to RQ2, the designer' practice-oriented approach was demonstrated by the rating of five elements seen as most important for a good designer (Figure 9). In relation to RQ3, designers expressed a practice-oriented approach through consideration of the project as a whole (Figure 10a).

Ultimately, the design managers' perception of the designer's role and identity is based on a *client-oriented* approach under the theme *Rapport* (section 6.3.1). A client-oriented approach refers to an orientation towards communication with satisfaction of clients. The social perceptions of from professors and design managers, concerning the designer's role and the attribution of characteristics, differ. Overall, the design managers considered that designers should be empathic, responsive and cooperative in order to achieve an excellent outcome. Thus, design managers take a *client-oriented approach* that acknowledges the potential for designers to accommodate clients' needs to the company's capacity to produce and deliver a solution. This is in line with Sun et al. (2011), who describe design managers as responsible for ensuring successful delivery of day-to-day design work, ensuring that required knowledge is captured and available to inform design, and ensuring that the design output matches the company's strategy and the client's expectation. This view of the design profession is in line also with the challenges highlighted by Hakatie & Ryynänen (2007) in relation to industrial design consultancy, where management and design practices have to adapt to market competition in the context of the client's evaluation of the services offered, based on fixed price bids. A "flawless" bid is based on an extremely high level of knowledge, and a good understanding of the client's processes and problems (Hakatie & Ryynänen, 2007). In relation to RQ2, the client-oriented approach of design managers is exemplified by the rating of the five elements considered most important for a good designer (Figure 9). The design managers client-oriented approach is underlined by their deep interest in the project's development phase (Figure 10b).

The perception of professors regarding the designer's role and identity is contribution-oriented and comes under the theme of *Creativity* (section 6.3.1). A contribution-oriented approach involves a focus on the innovative input the designer can provide. At the same time, the professors considered aspects of professionalism to be inspirational characteristics. In contrast to design managers, the professors saw the designer's role as questioning and challenging the state of the art, and proposing creative solutions. The professors took a *contribution-oriented approach* that acknowledges the creative potential of designers as key to meaningful change, especially in the early phases of the design process. Barnett (2010) highlights that universities aim, predominantly, to teach theoretical and formal knowledge, but need, also, to prepare students for the world of work. This *contribution-oriented approach* of design profession is aligned to much of the teaching design schools and the professional literature, which often romanticizes the designer as a creative genius whose work stems from creative intuition (Bonsiepe, 1994). The study by Haase (2014) which investigates PI in a sample of more than 3,000 Danish engineering students, found that *creating things,* i.e., being inventive and creative, was the most common characterization among over 40% of respondents. By governing the process of knowledge transmission, academics embody the discipline's intellectual identity and play an important part in shaping the future direction of the field (Littlejohn, 2011). In relation to RQ2, the professors' contribution-oriented approach was demonstrated by their rating of the five elements considered most important for a good designer (Figure 9). The professors also

demonstrated a contributions orientation by highlighting the early phases of a NPD project as being critical for a meaningful outcome (Figure 10c).

The approaches and views expressed by both professors and design managers are in line with the findings from previous studies. However, the present study highlights a critical issue: lack of alignment and coherence between the education and professional environments. While Littlejohn (2011) notes that each of the professors she interviewed considered it necessary to prepare students for their career by distancing design from the 'creative genius' model, we found that creativity was a primary focus for design professors and was reflected in the students' perceptions and underlined by the work of Haase (2014). The focus of design managers in industry is distinctly different and is focused on promoting designers' autonomy in self-management and decision-making during projects, and confidence and social relations at work. This provides some insight into the influence of the education and professional environments on identity construction (Dahlgren et al., 2014) and throws light on the changes to perceptions that designers have to face during their careers.

In the transition from education to a professional environment, there is a shift in social-perception, from the professors' to the design managers' point of view, respectively emphasizing the early and late phase responsibilities of the designer. Ibarra (1999) highlights that the process of constructing a PI is congruent with self-conception as professional, in which experimentation fosters adaptation of behaviour towards credible choices by important role-set members. Thus, it is perhaps unsurprising that the designers, themselves, expressed a mix of self-reflections and expectations about professionalism, which differed from the perceptions of both the professors and the design managers. While the results from the three groups are congruent with prior studies, the comparisons reported here highlight the need for a better alignment between education and practice, and greater support for designers during the transition from education to practice.

When asked to imagine the ideal designer and cite important characteristics, all three groups highlighted specific sets of elements that reinforce the designer's role and its attributes described above (see also Appendix 3, section 6.7.7). However, some additional descriptions and characteristics expressed by respondents, do not fall into the category of either PA or DS elements. These characteristics might contribute to a more refined understanding of the contextual differences in perceptions. They are identified in sections 6.3.1 and 6.3.2, but were not included in the analysis in this chapter. Further work could consider extending the analysis to include these additional DPI elements, using a revised DPI framework. Examples of these characteristics are Curiosity, Vision, Passion, Persistence and Resilience.

The influence of social-perceptions on self-perception adaptation

Throughout their careers, designers are involved in a lifelong learning process that allows them to identify as and be recognized as a design professional. Their construction of a PI changes according to the particular context (Cohen-Scali, 2003). The changing perspectives related to social- and self-perceptions, contribute to shaping DPI as an adaptation that embraces different values and beliefs. Professors and design managers contribute to the designer's DPI at separate stages in the designer career – in the education and professional environments. PI is linked to professionalism in being aligned to professional rules and being highly dependent on context (Trede, 2012b). The results of this study suggest that designers seem to be more moderate that professors and managers, and

integrate the concepts of both groups. The differences in perceptions regarding the designer's role and the characteristics of each social group, are assumed to influence the designers' own self-perceptions and understanding, and explicit expectations in terms of competency and professionalism. Figure 11 depicts the construction of designer professional self-identification (D) based on the influence of the professors teaching design (P) and design managers (M) in companies.

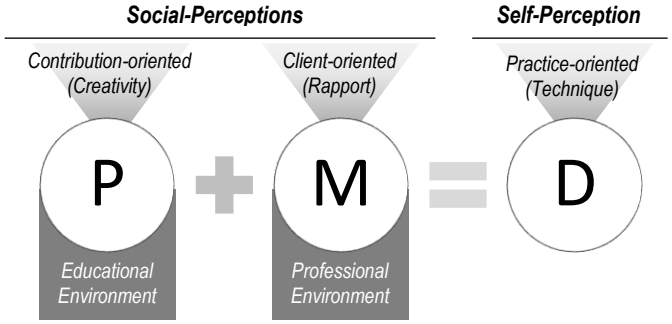


Figure 11. Framework for the impact of social-perception of designer's identity

The above framework, which is based on the results of the study, shows that designers adopt a third approach to the professional role and DPI elements, compared to professors and design managers. This distinction is defined in the literature as adaptation of the self to the professional environment to balance social-perception of role-models (Ibarra, 1999). Insights into this adaptive aspect were identified during the interviews: one of design manager, referring to personality test he had taken when he joined the company, said: "*It had changed a lot today, so if I do the same test [now, I] would score much higher on this. And it's called influence but I remember that the bird I can follow is the parrot. […] I've learned from going out with other consultants and see how they were*" (M4). Thus, designers learn and adapt gradually, first, by adopting the perspective of their professor during their design education and based on a sort of 'idealistic' understanding of what they will do as a professional. When they move to a professional environment, the perspectives of their managers and their work duties reshape their understanding of themselves. Hence, the views of both professors and design managers have a direct influence on the constructions of designers' self-perceptions of their role and abilities, towards achieving a balance between the ambitions of the education and professional environments. Grace & Trede (2013), asked students and educators in two allied health programmes, about their perceptions of professionalism. The authors concluded that formal education in the classroom and informal learning during professional placements were equally important for the student's development of a sense of professionalism.

This points to the importance of both education and practice for DPI. However, it points, also, to a misalignment between perceptions of and importance attributed to the designer's role and abilities, of these two main external actors. Their perceptions force the designer partially to deconstruct the expectations built during education in order to adapt to and pursue a design career. Tynjälä & Newton (2014) identify a series of challenges, reported by graduates, in the early stages of their careers, which underline the ability successfully to negotiate these issues challenges as inherent in the transition from education to work. One designer interviewee identified the difficulty related to the social-perception of professionals and what the designer is expected to do. She told us that:

"*sometimes I see it [the role of a designer] more as a method but when I talk to people about developing a product or something with more aesthetics I see how it lights in their eyes. I see that is what they think a designer is. And then, all of a sudden, I see myself more as that kind of designer*" (D4). By focusing on the new imperatives that emerge throughout their working lives, what is considered professionally responsible behaviour can change, involving a period of identity dissonance and renegotiation which can take up to three years to be resolved (Dahlgren et al., 2014). The challenges related to professional identification, are reflected in problems related to poor work performance (Adams et al., 2011), mental health (De Goede et al., 1999) and drop-out from the profession (Khapova et al., 2007; Worthington et al., 2013).

The early consolidation of a PI allows a smoother transition from student to professional, by promoting awareness of what it means to be a designer in practice. Several studies argue that, despite a focus on development of competencies and skills, the education environment provides enough space for both formal learning and professional practice, thus, identity should be incorporated in education to prepare students for practice in the workplace (Trede, 2012a). The identity process during education enables the student to adapt better to the challenges of the field (Evetts, 2003; Tracey & Hutchinson, 2013) and to identify those elements of practice that should be perpetuated and those that can or should be transformed (Trede, 2012a). A purposeful PI construction requires early career involvement, which the education programme can provide, and a pedagogy that starts by challenging and raising self-awareness about the designer's role and the characteristics of both novice designers and social actors. Awareness of professional values and skills should be aligned to the education and professional environments to promote an association of social- and self-perceptive expectations in the designer's mind-set.

6.5 Conclusions

This chapter examined how social- and self-perceptions of the designer's role and identity diverge across the three groups of designers, professors and design managers. We conducted an extensive interview study; the results show that the social-perceptions of professors and design managers, concerning the designer's role and the importance attributed to characteristics, differ. The professors have a *contribution-oriented view* and a strong focus on the creative and innovative capability of the designer, especially in the early design phases. Professors attributed more importance to elements related to a *designerly* mind-set and creative potential. On the other hand, design managers take a *client-oriented view with* a strong emphasis on the designer's capability to be empathic and establish agreement with colleagues and clients. Design managers attributed greater importance to elements related to the capacity to bridge between company and client demands.

The self-perceptions of designers, expressed a mix of self-reflection and expectations about professionalism that differed from the perceptions of both professors and design managers. The designers integrate parts from both external perceptions in a practice-oriented view. Designers attributed more importance to elements related to the need for a technically reliable project outcome, focusing on achieving a creatively satisfying result that responded to user needs through an efficient process.

The disconnection between the three groups highlights a problem for design professionals. Professors and design managers contribute to professional development at separate stages in the

designer career – in the education and professional environments. Thus, the differences in perceptions regarding the designer's role and the characteristics of each social group influences the designers' own self-perceptions and understanding, in which expectations in terms of competency and professionalism are explicit. The change in perspectives between social- and self-perceptions contribute to shaping DPI as an adaptation that embraces different values and beliefs. However, during this transition, designers' must overcome various difficulties in order to adapt to different social-perceptions. This work highlights the need for a better alignment between education and practice, and specific support for designers during the transitions in their careers.

This study adds to our understanding of professionalism in design by identifying and comparing the perceptions of the actors involved in relation to designers' professional development and identification. The results of the qualitative analysis allow deeper evaluation of the DPI framework and its PA and DS elements, from different perspectives (see Chapters 4 and 5) and suggests some new characteristics that could be incorporated in an extended framework to obtain more refined results. The work in this chapter should provide a basis for investigating the potential impact of the education and professional environments, and social influences, on the construction of a strong designer PI.

Limitations regarding the analysis of quantitative data are acknowledged in this study due to its qualitative nature and number of respondents. However, the triangulation of results from different methodologies and its clear pattern in the same direction provide a solid understanding of the trends from the descriptive statistics of this dataset. Some of the limitations related to this study point to the need for a better understanding of how identity develops over time and how designers could manage the psychological transition involved in moving from education to practice. Future work could examine the dynamics between social- and self-perceptions over time, the interactions between the education and professional environments and the development of DPI.

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6.7 Appendix 3

6.7.1 Interview guide for open-ended questions

- What do you think is the role of a designer 'generically'? And in the context of your company, what is there role?
- What do you think is the most important characteristics of a Designer in general? And for your company?
- How do you see the influence of DS and PA on the perceived competence of a designer?
- If you think on the best designers that you got to know or worked with, which characteristics of them made you perceive them as inspiring?
- In the same sense, if you think on designers that you met or worked with and somehow you thought that, maybe, they were nor really suitable for that job. What made you feel like that?

6.7.2 Interview questionnaire for importance attribution to DPI elements

Rate by importance the elements that makes a good designer	**Not important at all**	**Not so important**	**Quite important**	**Extremely important**	**I am not sure**
1. Ability to understand the design problem					
2. Provide deep thinking about the problem					
3. Evaluate the problem characteristics					
4. Ability to create abstract solutions / be creative					
5. Capacity to learn from failure					
6. Frame the design problem in a context / situation					
7. Having a strategy to development (use a method)					
8. Create its own strategy to solve the problem					
9. Ability to communicate clearly					
10. Ability to communicate directly					
11. Attention to details					
12. Empathize with audience					
13. Ability to establish rapport (harmony with others)					
14. Ability to collaborate					
15. Provide a proper communication of the work (documentation)					
16. Provide an adequate presentation of the work					
17. Good *'Design'* language competencies					
18. Foreign languages knowledge					
19. Basic knowledge in Design					
20. Focused knowledge on the working area					

21. Negotiation competencies						
22. Good Imagination/Representation ability						
23. IT Competencies						
24. Capacity to apply previous knowledge						
25. Competency for managing generic tasks						
26. Competency for delivering Job-related tasks						
27. Ability to plan the project						
28. Management of project stages						
29. Effectiveness self-/project assessment and adaptation						
30. Being ethical at work						
31. Prioritization of social responsibility aspects						
32. Developing ethical solutions						
33. Being emotional stable						
34. Sensibility to shapes and artistic contents (aesthetics)						
35. Social Abilities						
36. Leadership capacity						
37. Empathy with colleagues and peers						
38. Responsibility at work						
39. Punctuality at work						
40. Motivation with work						
41. Work hard						
42. Openness						
43. Confidence as professional						
44. Self-Confidence						
45. Be honest						
46. To not be arrogant						
47. Be patient with others						
48. Being enthusiastic and assertive						

* Provide any other competency that you think is important but is not on the list

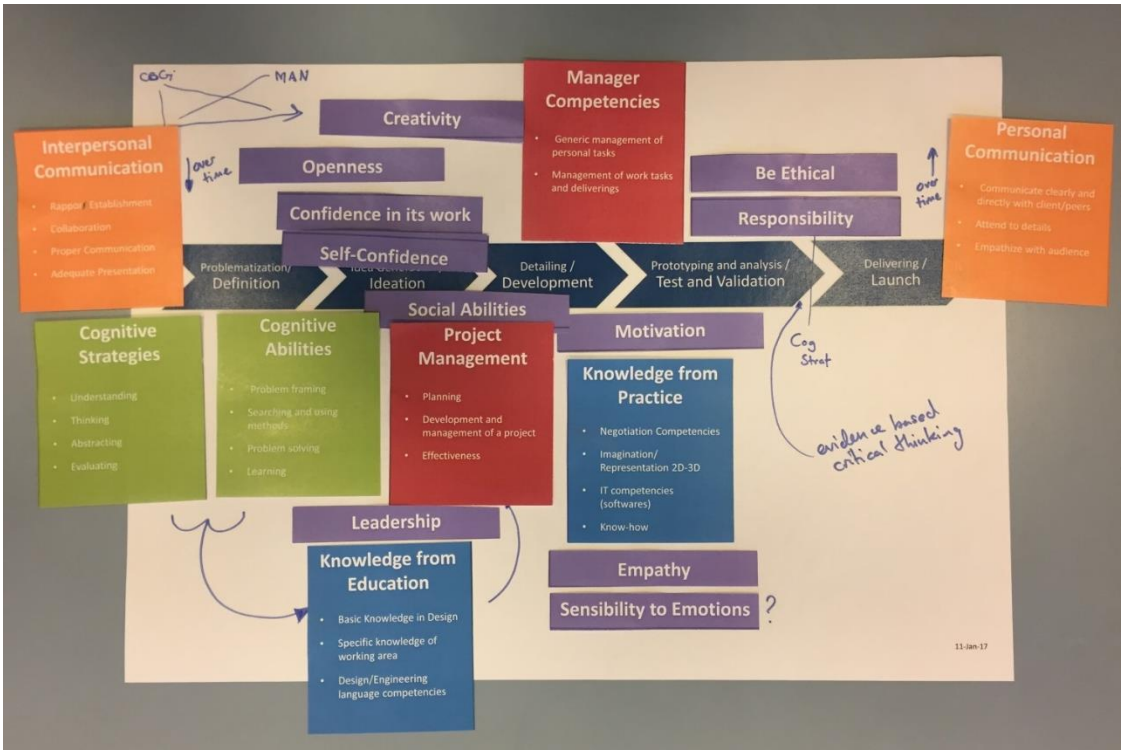
6.7.3 Representativeness of the questionnaire items per DPI category

CA	1, 2, 3	**EK**	17, 18, 19	**CO**	16, 43	**EP**	37,45,46	**OP**	24, 42
CS	5, 6, 7	**PK**	20, 21, 22, 23	**SC**	15, 44	**ET**	30, 31, 32	**RE**	38, 39
PC	9, 10, 11	**MC**	25, 26	**CR**	4,8	**LE**	36, 47	**SA**	35, 48
IC	12, 13, 14	**PM**	27, 28, 29	**EM**	33, 34	**MO**	40, 41		

6.7.4 Descriptive statistics from the questionnaire of importance attribution to DPI elements

	Professors		**Managers**		**Designers**		***Differences***			***T-test***		
	mean	*var (P)*	*mean*	*var (M)*	*mean*	*var (D)*	*D-P*	*D-M*	*P-M*	*D-P*	*D-M*	*P-M*
CA	3,37	0,05	3,33	0,06	3,36	0,05	-0,01	0,03	0,04	0,49	0,43	0,46
CS	3,15	0,09	3,08	0,08	3,18	0,01	0,03	0,10	0,07	0,25	0,18	0,47
PC	3,04	0,16	3,17	0,06	3,27	0,05	0,23	0,11	-0,13	0,17	0,28	0,36
IC	3,19	0,08	3,11	0,17	3,46	0,06	0,27	0,35	0,08	0,06	0,12	0,44
EK	2,55	0,07	2,61	0,27	2,89	0,13	0,33	0,28	-0,06	0,08	0,17	0,39
PK	2,91	0,11	3,08	0,12	3,06	0,07	0,16	-0,02	-0,18	0,16	0,44	0,18
MC	2,89	0,06	3,20	0,04	3,10	0,01	0,21	-0,10	-0,31	0,23	0,35	0,22
PM	2,92	0,10	3,01	0,08	3,03	0,05	0,11	0,02	-0,09	0,29	0,46	0,30
CO	3,17	0,01	3,42	0,01	3,29	0,00	0,12	-0,13	-0,25	0,26	0,36	0,19
SC	2,87	0,07	3,00	0,03	3,18	0,01	0,31	0,18	-0,13	0,05*	0,18	0,26
CR	3,24	0,11	3,250	0,34	3,09	0,16	-0,15	-0,16	-0,01	0,12	0,26	0,37
EM	2,71	0,08	2,75	0,01	2,55	0,20	-0,16	-0,20	-0,04	0,31	0,29	0,40
EP	3,13	0,01	3,21	0,04	3,24	0,02	0,11	0,03	-0,08	0,27	0,49	0,30
ET	2,90	0,01	2,33	0,02	2,85	0,01	-0,05	0,51	0,56	0,46	0,08	0,12
LE	2,72	0,01	2,83	0,03	2,68	0,02	-0,04	-0,15	-0,11	0,48	0,29	0,28
MO	3,18	0,37	3,25	0,17	3,21	0,37	0,03	-0,04	-0,07	0,33	0,45	0,39
OP	3,28	0,01	3,58	0,01	3,60	0,01	0,32	0,02	-0,30	0,13	0,44	0,18
RE	2,71	0,18	3,25	0,06	3,14	0,02	0,42	-0,11	-0,54	0,04*	0,32	0,03*
SA	3,18	0,00	3,42	0,06	3,41	0,00	0,23	-0,01	-0,24	0,17	0,49	0,26

6.7.5 Example of Concept map built during an interview session



6.7.6 Ranking from responses means and average variances per group

	PROF (1)	MAN (2)	DES (3)	VAR (P)	VAR (M)	VAR (D)
CA	3,37	3,33	3,36	0,05	0,06	0,05
CS	3,15	3,08	3,18	0,09	0,08	0,01
PC	3,04	3,17	3,27	0,16	0,06	0,05
IC	3,19	3,11	3,46	0,08	0,17	0,06
EK	2,55	2,61	2,89	0,07	0,27	0,13
PK	2,91	3,08	3,06	0,11	0,12	0,07
MC	2,89	3,20	3,10	0,06	0,04	0,01
PM	2,92	3,01	3,03	0,10	0,08	0,05
CO	3,17	3,42	3,29	0,01	0,01	0,00
SC	2,87	3,00	3,18	0,07	0,03	0,01
CR	3,24	3,25	3,09	0,11	0,34	0,16
EM	2,71	2,75	2,55	0,08	0,01	0,20
EP	3,13	3,21	3,24	0,01	0,04	0,02
ET	2,90	2,33	2,85	0,01	0,02	0,01
LE	2,72	2,83	2,68	0,01	0,03	0,02
MO	3,18	3,25	3,21	0,37	0,17	0,37
OP	3,28	3,58	3,60	0,01	0,01	0,01
RE	2,71	3,25	3,14	0,18	0,06	0,02
SA	3,18	3,42	3,41	0,00	0,06	0,00

6.7.7 Complete table of sharedness (% of respondents) for DPI elements on the NPD process

PA		DEFINITION	IDEATION	DEVELOPMENT	VALIDATION	DELIVERY
CO	D	0%	14%	100%	29%	29%
	P	50%	60%	50%	50%	40%
	M	75%	25%	0%	0%	0%
SC	D	29%	0%	29%	29%	43%
	P	20%	50%	60%	40%	20%
	M	25%	25%	25%	50%	0%
CR	D	29%	100%	29%	0%	0%
	P	40%	100%	30%	10%	10%
	M	75%	75%	50%	25%	25%
EM	D	14%	57%	0%	29%	14%
	P	70%	50%	40%	20%	10%
	M	25%	75%	0%	25%	0%
EP	D	57%	71%	0%	14%	14%
	P	70%	40%	40%	20%	10%
	M	75%	50%	25%	25%	0%
ET	D	29%	29%	14%	43%	14%
	P	40%	20%	20%	50%	40%
	M	25%	25%	25%	50%	25%
LE	D	29%	43%	71%	14%	43%
	P	30%	50%	70%	40%	20%
	M	50%	50%	50%	25%	25%
MO	D	57%	14%	43%	14%	43%
	P	60%	50%	60%	60%	40%
	M	75%	25%	50%	50%	25%
OP	D	14%	71%	57%	43%	29%
	P	70%	80%	20%	0%	0%
	M	50%	25%	25%	25%	25%
RE	D	0%	0%	43%	43%	57%
	P	30%	20%	40%	80%	40%
	M	25%	25%	75%	50%	25%
SA	D	29%	43%	43%	29%	29%
	P	40%	30%	40%	10%	0%
	M	75%	50%	50%	50%	0%

DS		DEFINITION	IDEATION	DEVELOPMENT	VALIDATION	DELIVERY
CA	D	71%	71%	29%	29%	14%
	P	80%	50%	30%	10%	0%
	M	50%	100%	0%	0%	0%
CS	D	86%	86%	29%	43%	29%
	P	70%	80%	30%	10%	0%
	M	75%	50%	0%	0%	0%
PC	D	71%	29%	29%	0%	0%
	P	20%	30%	40%	30%	30%
	M	50%	75%	25%	50%	25%
IC	D	43%	29%	43%	57%	43%
	P	40%	50%	50%	10%	20%
	M	50%	50%	75%	50%	25%
EK	D	57%	71%	86%	43%	43%
	P	30%	50%	50%	20%	10%
	M	75%	25%	50%	25%	25%
PK	D	29%	43%	57%	29%	29%
	P	20%	30%	60%	40%	20%
	M	25%	50%	75%	50%	50%
MC	D	43%	57%	86%	57%	43%
	P	10%	10%	90%	70%	40%
	M	75%	50%	75%	75%	50%
PM	D	86%	43%	71%	86%	43%
	P	20%	30%	90%	50%	20%
	M	50%	25%	75%	75%	25%

D = Designers
P = Professors
M = Managers

6.7.8 Example of transcriptions and coding from open-ended questions

i) Interviewees' coding and experience

	Professors		Managers		Designers
code	*Experience*	*code*	*Experience*	*code*	*Experience*
P1	19 years	**M1**	2 years	**D1**	4 years
P2	5 years	**M2**	2 years	**D2**	2 years
P3	5 years	**M3**	20 years	**D3**	4 years
P4	2 years	**M4**	5 years	**D4**	2 years
P5	10 years	**M5**	7 years	**D5**	2 years

ii) Thematic Analysis and quantification responses that mention each theme

			Nr. of responses		
Color code	**Themes**	**Description of meaning**	*P*	*M*	*D*
	Creativity	*Sentences referring to brilliance, mind-set, creativity, intention, or multidisciplinary capacity*	32⋆	24	18
	Technique	*Sentences referring to practice, design skills, methods or technical abilities*	17	23	20⋆
	Rapport	*Sentences referring to communication, collaboration, interaction, or empathy*	11	25⋆	11

iii) Counting of number of interviewees that mentioned aspects of each theme

	A. Professors			**B. Managers**			**C. Designers**		
	Creativity	*Technique*	*Rapport*	*Creativity*	*Technique*	*Rapport*	*Creativity*	*Technique*	*Rapport*
Role of the Designer	4	3	0	1	3	3	3	3	1
Impact on society	4	0	2	3	1	1	1	2	1
Values at work P and D*– on teaching M and D – role at work	4	2	0	1	3	4	1	2+1*	2
Most important Characteristics	4	2	3	3	5	5	3	4	1
IDEAL	4	3	3	5	3	3	2	2	2
INSPIRING	5	3	0	4	2	4	4	3	1
Undesirable characteristics	3	2	1	4	1	3	1	2	3
Balance between PA and DS	4	2	2	3	5	2	3	1	0

Text additions:	
( )	*Interviewee language vices*
[ ]	*Author inclusion for clarity*
[...]	*Omitted explanatory parallel story*

A. Transcriptions from Professors' responses

	1. Role of a Designer - What do you think is the role of a designer 'generically'?
P1	"The role of a designer is a professional who is capable in interpreting a good idea into a concept, and from the concept to an embodiment - into a final result. And if this result is a product or an intangible service it doesn't matter for me. I see the design objects as being more and more as the value proposition that comes out, and a value proposition can have very clear and concrete engineering elements in it but it also have elements of experience, user activity and understanding, and the transfer of value from the sender to the receiver. And the perception of what a designer competence should be to do that is everything from understanding the needs and wants of the receiver, [to] what do we have of possibilities to solve the needs or the problems. And the whole process of designing is the important part because we have different ways and models and flows and approaches to design, which is basically following some form of steady embodiment process that at the start you have something fluffy and at the end you have the result."
P2	"Challenging status quo. It's probably across all type of design domains. If you call yourself a designer, in my point of view, is because you think you are good at it, or because you think you are good at challenging the way people think within that domain. So, your challenge would be [to take] something that exists and try to make something new, but is challenging what was there in the first place."
P3	"There are 2 answers to this, 1 is what has been traditionally the role of a designer and the other answer is what it seems to work in going forward. And so, traditionally if you think of engineering design per se it is designing product, most of the time hardware - looking at the structure, looking at the function, and looking at the interaction between the user and the product. You can also expand this to large scale system design, where traditionally it's not just hardware but there is also mechatronics, products systems of software and systems, and then sociotechnical systems, services and so on. So that leads me to the next, the role of the designer has been changing quite a bit, cause now the designer in addition to engineering knowledge and human interaction knowledge. He needs to have thorough knowledge of the business aspects commercialization of services and products, and also legal aspects. So, there is a lot of constrains and standards and regulations. And so, as designers we have to be half lawyers and part MBA and also part designers. So the role all in all is quite big, it can start from having all the technical knowledge to be the mediator bringing in different teams or other teams together. There will be, let's say, if we look into the design of an urban space that isn't traditionally this hardware. That is much broader, bringing together the architect, the city planner, the citizens as co-creators of the space, [then] there is energy, expertise, water, that there is so much. So the designer is someone who bridge all this disciplines and brings all this together."
P4	"When I think about designer and particular designers' role, for me it's something that should facilitate the process of thinking in advance, so thinking beforehand. So, when you design something you need to consider many different aspects and by considering these aspects you need to foresee the future. So, because you're doing something in order to make your process or make your project better, at the same time you need to, in an absolute way, think about the process of the product and consider some factors that could happen in the future. So, their role is to put different elements together in order to standardize the creation, the creative process."
P5	"I'm a bit confused that you use the word designer and you use the word designer alone. Because I don't consider our student in design and innovation are designers. I think they are at best design

	engineers at best. If you want to include the word I'd would say design engineer, which I think is completely different from being a designer. […] I think design engineers my son in law is a design engineer, he studied manufacturing engineering in England. […] In his team he has designers who draw and think about colours and shapes, and he has engineers who think microphones and electronics and computer chips, and he brings them together. So I distinguish between designers and engineers. And I think design engineers somewhere in the middle who are able to do a little bit of both. I think one of the problems of our students in design and innovation students, a lot of them think they'll just gonna design, draw or think of good ideas. And [thus] they fail their exams in maths and physics because they don't do the work in those areas. I've always been an engineer, but ever since I was 18 years old I've also been very much interested in art and architecture. […] I think there is grey [area] between design engineers and architects and of course all architects work with structure engineers. The best ones have a feeling or good intuition or good knowledge of engineering. […] So I don't think that designers can be a good designer without having some mathematics and physics and technical background."
	2. Impact of a Designer – How do you think the design as a profession can impact society?
P1	"The designer is a some sort of interpreter, interpreting needs, interpreting opportunities, interpreting purpose. Is to develop society in terms of satisfying need, in an increaselly effective and sustainable manner."
P2	"If you take the role of challenging the status quo, in general people with the design mindset, I rather like to think of it as people who think designerly more than people that are designers. Because I know people that are educated as designers but have terrible design mindsets, and I know people who are educated as lawyers who are great designers. So, it's more about the mindset you have and if you take this mindset perspective, I would say people who are skilled designers - not educated as designers but that have a designerly way of thinking - they actually move things forward and that's what the designers do: they look how things are, they challenge it, they come up with something new — and that sometimes is successfully and that is actually what moves society forward."
P3	-
P4	"It can foster innovation for example, and also collaboration. Because when you design something, especially if it is a complex system, then you need to cooperate with many people and consider different opinion. So you need to include sometimes different stakeholders for example, and have discussion with them in order to see what are the elements that are crucial for the development of the process of the product that you're trying to design. And yeah, so the impact on the society and on the environment and on the economic is to bring many ideas together and to make people interact and foresee alternatives, alternative ways to generate something in the future. And also, consider all the relevant aspects that your innovation, your new product or new process, can bring to the context."
P5	"By improving the environment at all stages, in production, the working environment, the production environment, the use of resources, uses of water and energy and so on. And then the way their product impacts during use and during recycling and of end of life. Because we have a have a problem, some people think that windmills in Denmark are great, because they are good for the environment, because we don't use fossil fuels. Some people say they look very beautiful, slinder and iconic with 3 wings and so on, but these wings which are 90m long are made out of carbon fibre and epoxy; and what you do in 30 years' time when they are old? You have to cut it

	in small pieces and burn it or you can cut it and burry it in the ground or you could sail it out and drop it in the sea. It's terrible, and windmills are corrosive and that could be a big problem in 30 years' time and nobody talks about it. You could make smaller windmills out of wood, or something in-between, you could make something quite inefficient windmill, and using wood and then you could reuse the wood."
	3. Impact of a Designer – What is the main value that you put in your teachings/Designs?
P1	"Teach designers in 3 levels: what is the knowledge that students should have, what are the skills, what are the attitudes they should adopt (create a mindset). I think the mindset is what creates the designer. Without the skills and knowledge than is just an artist, or an anarchist, or whatever. So, I think that three goes together. I am very aware, when I plan my classes, that this lecture is about creating a mindset, is about excitement, [and] is about giving them something bigger that they thought they would think about when they came to the lecture. And it's also a cheap trick to get their attention. But once you get their attention, once they start to think creatively they are much easier to consume the skills and the knowledge."
P2	"First and foremost, specially design engineers, is not accepting the current answer. So, most students when they start their education they come over directly from school, and what they were taught there is that there is a right answer, you just have to figure out who have that right answer and you can use that answer. So, I really try to teach them to question things, question answers. So, if someone says that this is the right way to do it, it is your job as a designer to try to make sure that that's actually the way of doing it. And that's the skills that is harder from them to go from how they would normally think into actually dealing to question things. This is probably the most important thing, because this is a habit bursting. The second aspect is to train them to think creatively and creative means everything but basically train their ability to come up with new things, taking existing things and turn around to make new things, that transition. Because there is also something that they haven't being able to train to do."
P3	"Suddenly the designer has known his craft, so then ya, what we teach in the bachelor's most of it the technical drawings, the requirements, specifications, all this aspects they have to master their craft, the technical side of it. Increasingly so in the digital also, knowing much more about data and programming as it used to be. That for sure need to know the technical side. What I do think is absolutely necessary is also what we call, I suppose, systems thinking, to really understand the elements and the connections between the elements and also most importantly the potential knock on effects, this propagation effects this decision may have. So if you take out an element what does it mean for the overall system. So this is something that is really core and designers hopefully by nature have it. Yet it must explicitly has to be thought, this is somethings designers take for granted. But I think they can be proud of having this skill. And so if we help them at university to bring it up and give them examples. So there is another [thing,] what I think teaching at the courses is mental agility in the learning objectives of the course. And what I mean by that is having all the technical knowledge and the knowledge of human behaviour, all this and maybe some business models and other methods, design methods. All this various elements that you can think of, and be mentally agile, and combine them as needed for the situation to get to the solution, and also being aware of the thinking principles underlying your designs. So it is fundamentally about cost/efficiency or is it about human experience? So, what is that you're underlying in your design process? What is your goal it's not only the goal, because the goal can be there but you have different ways of achieving that. So, that is important that the people are mentally agile, and design engineers are in my eyes are change agents, they create the surrounding around us and for that they need to be agile."

P4	"What I do normally when I teach about business model design is to try to make them first of all analytical, so I want them to be strong in doing the analysis. So, the value corresponding to these could be like objectivity. And then, of course, being able to create something new. So it could be like creativity. I would like to foster their creativity in order to generate something new. So they need to do a good analysis and then, maybe identify the gap between the current situation analysed and maybe a future a future innovation and then, see how they can create something new in order to address this gap. And of course I would like that they consider the impacts of this process on the environment and society. So, consider all the stakeholders involved into the design, all the processes of the prototype they are trying to develop."
P5	-
	4. Most important Characteristics – What do you think is the most important characteristics of a Designer in general? And for your company?
P1	- Humility (in terms of understanding the context and situatedness) - Determination (persevere and keep going and trying) - Openness - Dig down into new areas that you never though before - Creativity - Basic engineering skills
P2	- Being curious - Persistent/ Irritating - childish ability to keep making questions - Accepting failure and being comfortable with failing and seeing it as learning - Empathetic - good listeners and curious about people
P3	"I think that designers need to be creative; they need to have a problem-solving attitude; they need to be strong in doing analysis; and they also need to be maybe try to use emotional intelligence in order to see what are the problems of people, the real problems. Maybe if you're trying to design something, because you are asked to do that, and based on a set of requirements, and maybe then talking with people do you understand that the problems are others [- different from what you previously thought]. So, you need to really understand what people actually mean and what they care about. And you need to be in this way a bit, in terms of the emotion I mean. So you need to really understand what they care about, and what they value, and also they need to be able to make synthesis at the end. So they do the analysis, they have a problem-solving attitude, they know what is the problem, then they write the problem, they analyse the type of solution. So they also foresee, they need to be able to foresee the future. Because then, when they design a solution, it shouldn't be a solution that is good now, but it will be good also in 5, 10 [years] depending on the time window. But then, of course, they need to be able at the end to make a synthesis and deliver. So, they also need to be able to deliver something; they need to be organized and getting things done. Not only creativity but also being able to deliver."
P4	-

P5	"I haven't met many designers in person. The most successful were those that were the most ambitious and they are driven and they push everybody out of the way, they push themselves up, they are not hiding, they want to be the big guy. Often ambition is an important thing."
	5. Most important Characteristics – What would be the characteristics of an ideal designer?
P1	"T shaped professional: Being both technically deep(anchoring) and have ability to communicate, go across borders, spot the stakeholders that are important, spot opportunities in the markets or in the receivers, to do different but follow the procedures at the same time, be derailing provocative without being anarchistic as well"
P2	- Social and empathic (Interests in people and good in communication with others) - Quick learner (whenever facing new tasks this person knows how to quickly gain the right competencies or knowledge for that job) - Super curious - Good at combining existing knowledge into new combination - Has little or no fear of failure and judgement - Visual imagination skills (the ability of quickly turn an idea into a mental image and then work with that mental image) - Good sketcher but also good with crafts in general - Sales person (pitching, convincing, wrapping ideas in ways that make people enthusiastic about it) - Humoristic (bonus)
P3	-
P4	"If I just, you know, vision the ideal designer I imagine someone with tools, handing tool, going around the table and measuring stuff, drawing. But also someone that is able to talk with people in a good way, and understand other people, and listen. You have to listen people in a proactive way. And yeah, include into your design, into your drawings, the inputs and the ideas. But without being too much constraint, because sometimes if you talk with many people they have very different ideas. So you need to be able also to facilitate the process. I envision someone smiling, very handy, with good capacity of seeing something that average people do not see, cannot see. So, good level of abstraction."
P5	"Awareness and empathy for others and openness and not being afraid to say your own weaknesses, not being prejudiced. Those sorts of people are not interesting, no good."
	6. Inspiring Characteristics – If you think on the best designers that you got to know or worked with, which characteristics of them made you perceive them as inspiring?
P1	- Trustworthiness (deeply professional, make you feel safe) - Very humble - listening, understanding, moulding their way - Hard workers - Very good at visualizing (good way of communicating)

P2	- Master all the necessary techniques - No judgemental thinking
P3	"Let me think. So there is some in industry, once I was working in industry and some here when teaching students and actually guess for both. I'm thinking of similar traits. So one [type of student] that inspires me is when they add to whatever I bring, so let's start with the students here. So when we teach something in class and we say: 'let's apply things in an exercise and [you can] find your own way', and [then] they add to that exercise, and they try things out, and they bring ways of solving the exercise that I haven't thought of. It's this noticing what is required or what could be there, and then trying to make that work. So really, hands on and practically bringing examples rather than sticking to what has been said, and also complaining. So the ones that really inspire me [are those that] they do, they act. What I think is a characteristic, another that I see in industry, is that there is also a long term trait - it's not just once. They always try to find different ways to make things work. It is that attitude of creating and showing. Perseverance, in this sense of not giving up if something doesn't come as expected. Perseverance it's right. If you look at someone like it's been written about James Dice and they put up their design principle how they work, and perseverance is one of those characteristic, when you go through 5000 prototypes until it works, and that works on the product side and it also works on the process side with the interaction with humans. You keep on training your abilities and testing and trying things out. And a third aspect is certainty, also maybe it is connected to perseverance. But I think it is more, also having that vision, having that overall long term goal, where you know where you wanna go - and even though, if you have no idea how you can make it work now, or in a year, or in 3 years' time. But generally it's the overall direction that is quite inspiring."
P4	"The capacity to create something, even though maybe they were time constrained, resource constrained. But the capacity to really create something, (so) to deliver. If you are a web designer you need to do graphic design and then at the end you create a nice book, really nice. if you are an education expert and you are designing a course for making people more creative then also, at the end of the day, you need to transfer to these people more knowledge about these topic and new skills."
P5	"Really bright people can usually do anything; they are good at drawing and seeing, imagining, analysing and understanding the technology. These are really bright people, but there's not many of them."
	7. Bad Characteristics – In the same sense, if you think on designers that you met or worked with and somehow you thought that, maybe, they were nor really suitable for that job. What made you feel like that?
P1	3 types: 1) don't get al.ong with the basic courses, basic mindset of this education - choose it wrong; 2),Ideator, only want to get the ideas without following the process and persevering on the ideas; 3) strive to be a designer because are too technical , too rigid - lacking flexibility on their mindset.
P2	- Not learning from failure - Not recognizing when something is not optimal, or taking feedback

	- Arrogance, believing you are right all the time - High thoughts about yourself or your work
P3	"One aspect, not sure whether it counts, it's a small example, it's in graphic design. Working in graphic design in various outlets in various research projects and aspects and maybe there is sometimes, maybe there is cost driven aspect. When you make corrections or you say 'ok, this is my ambition', what I wanna reach with the project, and then they transfer it in a graphic style, and that's very good. But then, it's the details afterwards, to really be very meticulous and aligning text and font size consistency. And that's what I would call the craft, the detail attention. And if you correct it, and you make suggestions, and it still not there the next time, and third time, that's something I don't praise very highly. But I'm not sure [if] it is the ability of the designer that I question. It's maybe the execution and then, so maybe designers who are very good at conceptualizing and coming with the ideas and mabe should team up with some who merely executes and does the detail. I'm not sure I can answer your question. That is the only example I wasn't impressed with. […] There is different process phases through the design process where different abilities are required. So for example what is in my mind, as a user or as client, that is undesirable towards the end of the design process is when the designers still keep everything open and tries to accommodate for absolutely everything. At the end of the design process I would expect the designer to be quite forceful and strong and say: 'look these are the decisions we have made now and we are doing this now'. Whereas, at the start of the design phase, that's exactly a desirable trait to open the space up and let various solutions emerge. So maybe undesirable is when the designer confuses those stages or doesn't communicate adequately what it is to be expected at certain stage."
P4	"If they are not organized, first thing. If you're a really a not organized person it might be really hard to work. If you do not respect for example the time schedule of other people. If you are a passive-aggressive person. If you don't understand other people's opinion or don't do not respect. If when you communicate it seems that you are killing someone, you know, if it's too aggressive. Yeah, if you use violent communication and trying to impose your idea. This I do not associate it with good designers."
P5	"The ones I was disappointed in, the design students, are the ones that think they can, like children like drawing nice things and they think is nice, usually what is fashionable and they have no philosophy they have no dream no big idea. If they have no reason for changing the world and they just want to make nice patterns and nice looking thing, they just want to make stuff. […]
	8. Balance between PA and DS – How do you see the influence of design skills and personal attributes on the perceived competence of a designer?
P1	-
P2	"To be a good designer is a mix of these two. So if you have super traits — a lot of people are horn super creative, super curious, super empathetic, so they have a lot of the traits - and then they will need just a couple of skills to be good designers. While other people have less of the traits — they are born as more introverts, not too social, maybe not too visually oriented, and all this things that are actually skills so they have to do a lot of training and they need a lot of skills to compensate for the traits. So, there is a mix where you need a balance to, and if you have a lot of one side then you might need a little less at the other."

P3	"Ok. So, yeah, certainly it needs to come together. And maybe, even though I didn't term as such, but that's what I meant in saying [that] we have to know our craft as well as being open and agile to see the different situations. So, they certainly need to come together. Also, if you as a designer have the attitude or the mindset of creating new solutions, and living with uncertainty, and it doesn't bother too much, while you go through the design process thing are open and uncertain. If you have that mindset, then it will help you bring the different themes together. On the other hand, [I am] not advocating that everyone should be like that, because it also needs people who are very comfortable doing very detailed calculations and want to be doing that, it need that as well. So, answering your question, yes they need to play together and they need to be congruent. You cannot, it's hard to explain, but they definitely need to come together. I'm not saying that are not personal attributes that every designers should have, or that some that are better than others. So there are certainly not one type that suits all of, or fits all. We need to have good combination of personal attributes as personal skills. That's maybe, in some ways, in some educations. If you as a professor are [not] as agile in your mind, you may teach one mode or one way [that] a designer should be. But there is many different ways I would say. There is no rule, but there are clear goals, clear ambitions."
P4	"I think there is a kind of interaction because, of course, if you have personal attributes that are somehow coherent with the personal attributes that configures a designer, then you might be (maybe) more motivated in engaging with design activities and (maybe) you could tent to be happier while doing design activities, and so maybe this could reinforce your learning and your development of design skills. But I think there is [also] something that could affect this link. Because I could also imagine, I guess, that (maybe) some people that think that they are really good in terms of personal attributes somehow they tend not to train so much their design skills, because they already think that they are very good. So they are very secure. And instead, (maybe) the other people that think that they do not have everything in terms of personal attributes, (maybe) they feel a bit insecure so they tend to look for more education in terms of design. And maybe at the end, they will have better design skills than the other. I think there is a there is a strong link but there is something in the middle."
P5	"I don't know. General soft skills like being able to understand other people, observe whether they are happy or not, pleased or not. Those sorts of soft skills I don't know whether they are innate or they are learned. I think [if] they are those sort of skills [that] are [good] to be able to communicate, [then] I believe they are just as important as the technical skills. But whether they are extrovert or introvert, whether they are aggressive, [or] ambitious. If they have that sort of soft skills, personal skills, whether they are good at learning or good at keeping going, tenacious ambitious [then] I think that's important."

B. Transcriptions from Design Managers' responses

	Role of a Designer – What do you think is the role of a designer 'generically'? and in the context of your company, what is their role?
M1	"There are a lot of roles for a designer. One of the fundamental thing is that they have the right background, that they know their skills, and they can take some decisions based in what they know. A designer has to be good to cooperate in a team.

M2	"The role of a designer is to create. To help to develop visions among our clients of how they can perform better with whatever they are doing and then translate it into some kind of engineering work, some technical stuff."
M3	"Find out what is good for the company and for the customer. Find out functionality and form, and the production, accomplishing the function that is needed."
M4	"It's a big question and anything is very much depending on the project type, and the field you are in, what kind of company it is. Obviously you can say maybe less the company but more like are you in the pharmaceutical industry, or you're in the shipbuilding, or whatever? I think it's quite important that is because the designers or role this is quite different. It's almost too big [of a] question I think. Because the role obviously develops depending on the phase that you are in. (…) I think that from my view that designer should also be included in the requirements, selling in quite early on, also in what makes the problem. So before there are any intangible products or services they should be included in, and trying to scope it, and trying to figure out what the product should do from a very early phase. It shouldn't be a marketing only exercise, which is the case in quite a lot of companies. And even before considering going out and asking people and making the analysis they should try to do quite substantial amount of preparation before that. So, it's much more focused when they go out, and try to figure out what the next part is going to do. So, from an early phase on they should be included in the specification of the product and the concept, and pretty much be all the way through. You can say, until they launched the product and getting a lot of the experience from what all the limitations that they have made or the errors. The whole loop should be there for the good design ideal."
M5	"I think of design as creating something new, it could be a physical things or a service. Usually I work with designing physical things, and I think that the role of the designer in that sense is creating, or facilitating, or making sure that something new is created that solves a need or a problem, and it meets the demands. Haying the ability to first understand what the problem is necessary but also figure it out what is the solution and combine the two of them. So, it would be at the problem area both the context and the user but also all the other stakeholders. Solve the problem of area and context and them bridging that with the technical solutions."
Role of a Designer - What do you think is the role of a designer in the context of your company?	
M1	- Cooperate and see the project from all the others' perspectives in the group - Take fast decisions
M2	- Vision creation in the clients (very difficult task and not much engineering, more B2B) - Conceptualize some ideas
M3	- Make some first trials and develop prototypes - Eventually you make a final design of a product or service
M4	"We do two things: we construct [the product] ourselves so we know it's designed for the customers, and the other part of this is training in robust design. So when we've been to the

	customers, sometimes they want to know how we did it fast, how we gain the quality so fast. So they want some training in that, and we're sharing our expertise in some training. What I do is training and the other part is mechanical design. […] I'm included in from the early phases into also quite late phases where maybe I do mechanical reviews and things like that."
M5	- Understanding the problem and the situation the clients are in and trying to find a solution - Helping the clients to make more money or being more innovative - Seeing how technology and technical solutions can help the client - Teaching them why some direction would bad or good, guiding them in their choices
Impact of a Designer – How do you think the design as a profession can impact society?	
M1	-
M2	"It's about creativity, visions and ideas that differentiate us. Create something new and innovate"
M3	"Creating products to improve people's life"
M4	"Well, (you can say) when I was at Novo Nordisk the potential of affecting the society was very very small, because it's virgin projects that will ever be anything. But if you come out with something that is radically changing the way diabetes is the treated then the effect is quite big but the chances are very very small. And I think that it goes for a lot of design professions that your chances of getting a big impact is very small. Also, if you can make a great impact in your profession, the chance of getting things on the market, giving it all the way through, is spiritual. But if you do not make that much of an impact on the society, or on well in general, then I think it is quite easy to come into the market with the product. I don't know if that's rule but maybe we had something that you would consider. You can put a lot of spam products on the market without doing anything, but sometimes you do something dramatically that will change it. And so, I think that a lot of non-bad-new-adding designers are there but [to] the hell, because there's always someone who really can say that moved the marks. But yeah, I don't think that they necessarily change the world. So, I won't say that they are more important or less important than any others in the development."
M5	"Often the designers' role is to lead or to be a direction giver, see opportunities before other people see but also helping society by doing that. You have a responsibility as a designer to try to make things better not only for you but also from other people."
Most important Characteristics – What do you think is the most important characteristics of a Designer in general? And for your company?	
M1	- Cooperate - Know your professional things skills - Big eyes and ears and maybe less tong to be able to grasp what kind of surrounding you are in, and then interpret that and find out to create something new in order to make a better place or use.
M2	- Good in listening, Good in observation - Good translation skills from visions to ideas which you can further materialize

M3	- Cooperate - talk and work together with people - Make solutions visible - Get ideas and sketching - Know a little bit about a lot of things - Creativity
M4	"I think it is to be a good listener; and a good observer; and a good analyst. That will than go hand-in-hand with the others, so that that's very important. And the other thing is that you shouldn't be afraid to change your concept. You should be open to change to other concept throughout the project, but you should also be focused on being finished and try getting something out there. Often you can discuss a lot and without being able to get any facts. So, then it's just to go do. I think that a lot of projects is killed due to someone saying none reasonable reasons. It's because there maybe aren't any matrix so it will be just discussions going on and people's opinion. So, you should be able to quantify your products in some way. That's very important, you should be able to explain your products to others in a very short manner. So you did the elevator pitch but including visuals [rather] than another. That is extremely important also if you wanted to sell but simply to explain what you're doing."
M5	- Being open and seeing opportunities - Wanting to chance something into the better - Being curious - Being positive - Have a quite high level of empathy* - Having both: good understanding of people and technologies
Most important Characteristics – What would be the characteristics of an ideal designer?	
M1	"Mix of personal and professional aspects. Half and half, I think. You have to be good at your skills but is more important that you are good to cooperate, and you can do your job quickly and you are dynamic - when things go wrong we have to find a solution very quickly. Being a good team player, help each other proactively."
M2	- Have some king of natural talent - Train on necessary skills to fit in that specific company
M3	- Good in getting new ideas and combine them (innovation) - Talking to people
M4	"I don't know ideal designer overall I think you can make an ideal designer for a specific product or for a specific industry but I don't think there will be one size fits all for all kind of distinctive projects. I don't think that makes sense. Well yeah, you have to be creative, then you have to be systematic, and you have to be able to analyse, and you have to be able to express yourself in all kinds of visual ways and present, you have to be into the detail, and you have to be able to be to allow yourself to be frustrated, and then

	you actually have the courage to trust in yourself to as an expert, don't take the users or the customer words for granted, just be very critical. Yes, there's a lot of stuffs you can put into this. You also have to be able to calculate at least the most simple things."
M5	• - Being able to see opportunities in an overall level - end in radical change and bigger impact • - Being bold and trying to design something that would impact a lot of people • - Good network or team for help in your vision. • - Being open to dialog and criticism from others • - Surround yourself with people that challenge your ideas
Inspiring Characteristics – If you think on the best designers that you got to know or worked with, which characteristics of them made you perceive them as inspiring?	
M1	"Do things without asking the manager - solve the problem. Be more independent and do things by themselves. It characterizes a person that has been in the business for longer time."
M2	- When there is not a linear development, radical changes surprises you - Creativity - Good at some marketing things (not related to being good designer but to get known) - Engage in the project, are passionate - Flexible to suggestions and feedbacks
M3	- Can discuss materials, details, mechanical engineering aspects, etc (have a broader view) - Combining information from a messy field, extract the most important parts and then put down that in a very structured way both to be presented to the people that you are designing for and for your client but also for you and for your team.
M4	"To be honest I haven't met that. I mean maybe it's because I'm too hard to impress, but I haven't met that many working 'wow! That's a really great designer'. I think the ones that made the most the most, the greatest, impression on me as you can say are very professional and highly skilled. One was, and also surprised me with other talents. is it's actually the boss I have right now, it's not because he can do the same as me - there's a lot of things that I do better than him - but because he is just so skilled in mechanical design. And even though he is the top of the food chain in (company), I don't think that anyone was technically approaching him in his level. So he has the depth and the expertise, but he also have these for communicating some things, and he's very bold in his way of approaching people, and he can also see company strategies in a different way than other people do. And then he surprise me by being very creative and his approach to, for instance, brainstorming. But also in his intern in the human skill is also very developed with which was surprising to me. So I think that being the boss of a lot of people and still having that high talking expertise that he can he coach, I admire that for sure. there's so many bad project leaders they could be part, because they are project manager for one project, and even if they develop whatever they basically just looking at the progression and they're not intuitive to technical things, so they're not able to challenge you technically which is a huge interest."
M5	- Imagining a solution is often not that hard when you understand the ground.

Bad Characteristics – In the same sense, if you think on designers that you met or worked with and somehow you thought that, maybe, they were nor really suitable for that job. What made you feel like that?	
M1	- Being stable - Don't say more than what you can stand behind - Disturb the group by talking to your neighbours - Do not prioritize to solve a crisis in the project instead of personal things (like gym) - Take a wrong decision because of the lack of knowledge - not be humble
M2	-
M3	- If it's too unrealistic, out of context, and maybe not aware of themselves.
M4	“That would be not being able to communicate, and not being able to observe. And run [off] about gaining new knowledge in in a new field, if you are too narrow in the way that you see things, then you don't have any curiosity in people and technology.”
M5	- stubborn and not flexible to change, not humble - Not being open to seeing the world in a different way that you already do - Start by having a very concrete idea of what do you have to do and ignoring critics and different points of view - Not basing empathy and sticking to your own points thus missing new - Communicating insights from the users to the technical development is always difficult - Have an openness that every project is different from what you did previously
Balance between PA and DS – How do you see the influence of design skills and personal attributes on the perceived competence of a designer?	
M1	"It's a mix. You have to be good at your professional skills but it is also very important that you are able to listen to the others in the group and interact with them, and understand their problems and find the best solution. You have to make a compromise between all the technical aspects and the production of it [the product]."
M2	"Can you learn to be creative, for instance? There have to be a combination, because obviously you can have a natural talent for designing but there are also a lot of tools and methodologies by which you can do it in a more efficient way. So you have to balance both."
M3	"I like to sketch. So, when I'm doing this I think it reflects on me a lot. I think they [PA and DS] relate to each other and they are both important"
M4	“I think that the one being open and honest, and being observing not just passing through what you just do, the problem that you have in mind. It’s very much a personal thing, how your behavior [go]. And it could be very hard for people [to be] just sitting on a chair and listen to each other, and observing what they're doing, and being open to others ideas and concepts.

	And I could say: 'yes, you can learn that'. You can just say now: 'I should be open and honest', like [if] you can do in every brainstorm session. But there's a great appearing just hearing and listening. I mean if you are, let's say, 25 when you get out of university and you haven't developed that skill yet [than] it's quite hard to. There is a lot that can be taught. and then I think it's for a reason that that when they do, for example, if you're going to be employed and they do a questionnaire that you have to fill out and then you get your they use this disk for instance, you know that person persona profile, and there's a reason for that. That's a lot of companies that use it because it's just tells a lot about who you are. The thing is that I know [that] they try to put you in a box but when I look at people's profile, because you can see that on intranet and you can see these forms and characteristics, and you can look at everybody's profile. And I think it fits very well but the impression that I have people. Some of them they're great designers but their profile is very different, and you can also see that in the way that the strengths and their weaknesses are. So that's very much personality but you can also learn to be in a special way. It's about being more outgoing, and the more being able to encounter people, and the way that you are. It had changed a lot today, so if I do the same test [now I] would score much higher on this. And it's called influence but I remember that the bird I can follow is the parrot. Yeah, but it's very about being more talkative and that is something that you can see. I've learned from going out with other consultants and see how they were. So coming back to the things, you can definitely change your behaviour and then you can also do that as a sign but I think that it takes a longer time. They really have to push yourself to change those characteristics compared with the more design skill That being said, I think one of the things that I didn't mention was that the characteristic of being systematic in the way that you do things. If you can do and show that you come up with the concept in a systematic way, the security of the one who is going to receive it is much greater. So if I can get some new stuff, and I can do it in a way that the customers feel secure, I mean that's where you want to go. And if I can show the path to the new concept in a logic and convincing way, then I have the customers' right where I wanted and I probably also have a very good product. And if you come up with a concept and you cannot tell why you ended there, I think you're in a quite weak place because it shows that you don't understand the customers in the end. And that's much linked to being systematic and seeing patterns and stuff. I did a lot of graceful facilitate the brainstorm sessions and I've always used methods. I never start with a blank sheet. I think yeah, so you use a lot of different methods to come up with new, and then to force people in the room to come up with new ideas. And it is quite hard because you really have to push people, and you have to use different kind of methods because some are more visual than others in the way that they express themselves. Then you have to think about that and it is a lot of you knowing the different methods are useful there. "
M5	"Often when we look for new people to join our team, of course we have a package of technical skills that we are looking for. Sometimes it can be hard to find those competencies but often the most difficult part is to finding the right personality traits that goes along with the trained skills. It's probably a bit more important with the personal characteristics because despite some of them [DS] you can also train - like collaboration, group dynamics, the ability to also be able to talk to people, go out and investigate - but is easier to train these skill set of e.g., how to do service design, how to do user investigation, how to build stuff in a certain program or programming, or electronics design schematics. I think that is for us easier to teach them than certain personal skills that we find necessary to work."

C. Transcriptions from Designers' responses

C1. Role of a Designer - What do you think is the role of a designer 'generically'? and in the context of your company, what is their role?	
D1	"I think the role of a designer is not only to solve problems. It is pretty often described as if you have a problem then you solve the problem. I think the role of a designer is also pretty much to see possibilities to actually find out where your design could be a difference. I think the designer is not only a problem solver. The role of a designer is come up with unexpected things"
D2	"he/she is the link between the very technical aspects of development, such as productions and assembling, and the users. Someone who knows something about aesthetics and costumers. It is the design engineer task to figure out what do they [costumers] want and meanwhile understand how we can produce it, develop it. And then, combine this two into something practical and meaningful."
D3	"It is to make better products for users, and maybe even foremost to make sustainable products. That's my big passion."
D4	"That very much depend the job of you have, the company that you are in. For me, it's a way of thinking, a method. The way that I perceive a task from when I get it to how to solve it. As a designer I have a backpack full of methods that I can use in a way to get to a certain outcome. Sometimes I see it [role of a designer] more as a method but when I talk to people about developing a product or something with more aesthetics I see how it lights in their eyes. I see that is what they think a designer is. And then, all of a sudden, I see myself more as that kind of designer. But as an engineer and as a consultant I see it more as a method."
D5	"It is to be visionary, because within an organization they will always be people who are working on the incremental efficiency of the product — to increase the performance of the product or make easier production — or the need of the user, incrementally. So, I see the role of a designer in being able to give radical changes to a product — largely produced - and also that you can follow your deign into the production, to bring it to the next level."
C2. Role of a Designer - What do you think is the role of a designer in the context of your company?	
D1	-
D2	"Create a concept that is valuable."
D3	"In our company it does maybe more than half of what we do, we decide products for our clients. That's almost all what we do"
D4	"The use of methodologies"
D5	"To be able to handle the whole project, from the idea to making it become true."

	C3. Impact of a Designer – How do you think the design as a profession can impact society?
D1	"The only impact I can see from the designers to society is from their designs, because that is their way to participate in great debates."
D2	"Problem solving in general, maybe dealing with problems in the everyday life... it is the designer task to find a solution that benefit the people"
D3	"Definitely, of course engineering in general its pros and cons."
D4	-
D5	"[Designers] give people hope and inspires people when they do something that is aesthetic. It is funny because when you see something beautiful you think it is good thing and is not always like that in reality but that is what the designers can do. They can create something which also aesthetically gives you an interest in the actual function. So people would very often choose something, when they buy a product, that is actually pleasing to look at or interesting to use."
	C4. Impact of a Designer – What is the main value that you put in your teachings/Designs?
D1	"Make the students work in a certain way. You always have this idea that your imagination is really great and has no boundaries, but in design the imagination is the boundary and the only way you can exceed the boundary of your imagination is by working with your hands. You cannot think on the wright solution, you have to come up with an idea, test it, change it, test it again, and go through the process."
D2	-
D3	-
D4	-
D5	-
	C5. Most important Characteristics – What do you think is the most important characteristics of a Designer in general? And for your company?
D1	- Ability to surprise himself - Imagination
D2	- the ability to understand the [holistic concept] problem as a whole, something that is part of something bigger - The ability to draw a method for a project, how to solve it
D3	"So again, is personal so I think the most important thing is the inventive side of it. Innovation have to bring something new to the market and succeed in the market, that's the key work. Innovation here has to bring [something] new and successful in the market. So for personality, I guess, [the most important characteristic] is curiosity. Although that is really a mix, this is important. So for curiosity I guess is across the board.

	As important professional skill as a designer, I don't think there's basically one. So I cannot name one actually. It means it's so many disciplines basically, for designers to understand it. So for us here it's maybe very much a project and management, that's very important as a consultant because we need to take of that. We have to run projects so that's probably the most important for us here as a consultancy but otherwise it depends on the job that are you going to design."
D4	- Collecting the data and how to measure in order to get the right outcome - See all of the different path and how they deliver data from one phase to another. See the whole span of a project and how the different phases work together to deliver a certain outcome
D5	- Bring something from inside my head - ideas - to the paper - Share an idea that attracts people in a more practical way (both inside and outside of the organization)
	C6. Most important Characteristics – What would be the characteristics of an ideal designer?
D1	- Energetic - not bailing out (standing on his opinions and fighting for the important details) - Be able to pinpoint the important details in your design
D2	- Imagination - Willingness to listen to the problem - costumers and users
D3	"I think it's then [that] the analytical part is really important too. And I guess we also use that in most of our projects. So we need to define what is the basic problem, and focus on there. We need to break down the problems and focus on the steps that are the first priority basically. Somethings needs to be solved at a fundamental level and if we don't solve those it's just a waste of time to address other things. So I guess you have a very much that analytical skill that is required to recognize them as early as possible. And I guess [for] my idols, as I see from the engineering and design is (I think) that the word ethics is quite strong as well. Maybe not as strong as I have, but it's too strong in some cases. But I really just have this drive to get things done. Like, to put basically working life before anything else. So I start out working 60 hours a week that dedication - dedication maybe it's better [word] – dedication of time, and these personal resources towards the work that that has being carried out. I think it's also kind of strong in most of the really strong idols that I see, that you really need to have that drive if you really want to step out in the crowd, at least. Coming from Denmark, I think that what was really interesting, of course, is how can you still have a work-life balance, and learn from these guys that are just married to their work."
D4	-
D5	- Empathy to understand the other peoples' needs
	C7. Inspiring Characteristics – If you think on the best designers that you got to know or worked with, which characteristics of them made you perceive them as inspiring?
D1	- He is not doing whatever people are expecting him to do - driven by passion - Breaking the conventional rules all the time and making his own style in that way - Able to think out the box and draw on other people that can assist with knowledge or information. Connect the different stakeholders around the product

D2	- Dedication / focusing on this product and putting effort in the project - Persistence - Wide knowledge - large understanding of who can give the information, networking and communication skills
D3	"I think the passion like this enthusiastic gear drive that shine through, that you can see that this person is dedicated, suited to these things they're working with. I think that's really inspiring when I see that around me, of course. I really like this when you can see there are new ideas, and they are successful in bringing them to life whatever circumstances they can be in. that's kind of a result, because they're probably a combination of a lot of things. I don't know, I don't have the recipe for that exactly. Are there certain traits that encourages this? and that's a good question, and probably going a bit back so you need the mix again. I mean, you focus on individuals. What's really strong in many cases, I supposed, you could get to see while [they are] working. So that's really powerful, when that works. And that's maybe when we come back to what as inspiring to see people that are good at engaging their colleagues, and that's encouraging that you work. That is increasingly so, required for actually coming up with novelty solutions and good design. I mean, we have a few cases that are quite simple and you can manage with a one-person army but (I mean) [when] increasing we need to have a lot of integration, and big teams to solve anything. The teamwork design is really increasingly important and I think also the curiosity is its back on the people I have worked with, that are inspiring."
D4	- Have some in-depth knowledge or academic knowledge and combine with what they see in the real world - know how to translate that into real world - Being very secure about on how to draw up a method for a project
D5	- Being able to use technical knowledge from other field in order to solve complex problems - Approach to leaning - being able to learn everything
	C8. Bad Characteristics – In the same sense, if you think on designers that you met or worked with and somehow you thought that, maybe, they were nor really suitable for that job. What made you feel like that?
D1	"People who distance themselves from the real world, the society or the people to whom they are designing for. If you don't want to engage, if you don't want to get out and meet the clients, and see the workshops talking to the people that make you realize that you are a designer, than you shouldn't be a designer."
D2	- Too focused in certain aspects, too early, that would block into a thinking pattern and not explore enough opportunities - Shyness. A person is afraid of talking to people - Being isolated or unfriendly
D3	"Back again to the teamwork, that we need this diversity to make innovation work. So, of course, it will always be bad if you only have one type of person in the team because we need the diversity. So often too much of a good thing is probably not a good. But that's not really about it, it's more about group dynamics. And so I don't think I've met someone who was like completely non-suited for it. Again, going back to my previous, if you don't have any curiosity to seek out new things it's pretty hopeless to work as designer and innovator. I mean, people have do have that. Especially if

	they are put in ministration that inspires curiosity. So again I don't think people exist that don't have this trait. There is definitely adventures to have more of that, I guess. It's always a good thing, even if it seem to have some uninspiring person in the team that just base thing down sometimes, you know. So yeah, I don't know one person that's not suited for design."
D4	- Lack of academic knowledge - Being very much biased in different ways - Going far away from the methodologies that I use and know
D5	"Managers [not] being able to fit the person and the right part of the project. Maybe they are not unsuitable but rather in the wrong part of the process."
	C9. Balance between PA and DS – How do you see the influence of design skills and personal attributes on the perceived competence of a designer?
D1	"Design can become very personal. So, if you cannot come up with a solution is almost like if there is something wrong with you. As I think there is also, as much as you professionalize as a designer you should be able to distance yourself from that idea that the design is you somehow, because otherwise it can be extremely though when you are facing a design crisis. What I see in school of architecture is that, when people enter the school, at the start it's very different what they bring into their studies in terms of experience from other studies or travels or whatever. Whatever design skills you have you need also kind of a drive and also, something that is very difficult to teach, the ability to create interests to create atmospheres. As a designer no matter how many design skills you have, if you have no drive or interests it's very difficult to come up with ideas. Somehow, also have to see shapes, solutions, ideas, connections..."
D2	-
D3	"I think definitely curiosity is a driving thrive force to actually want me to do things. So in that sense that should be you. But again we also relate in stuff like that. I mean it's sort of ingrained as an engineer that we want to do things the easy way, and that's really important for efficiency in the projects. I come from the design innovation background and it's really emphasize on need the mix of people, and you need the mix of traits, regardless almost of whatever sign assignment. And I think I still believe that is quite true in professional, that we need quite broad mixes for most skills actually. Yeah, I mean, I have quite a high standard for… the job needs to be done. I mean, it could be variations to that but I think we need all of all the sides. I guess the project management is really the key to making sure that you actually take advantage of the pros and cons of different persons and their professional trait."
D4	"The personal skills affects in all types of jobs and skills."
D5	"Curiosity in life, as a personal attribute, is very important and very connected to the skills of inspiring other people - creating a product in a mock up that can show you just a little glimpse of what can he done, or a drawing that can give the people an idea of what can be the future."

7. Discussion of contributions

This thesis research had three main objectives: 1) Identification of the elements contributing to DPI, based on the mapping of descriptions in literature; 2) Understanding DPI development over time in the contexts of education, awareness, expectation and motivation; 3) Understanding the differences in self- and social-perceptions regarding the designer's role and the DPI elements (see Table 1). The research approach and basic assumptions were defined based on the literature review, and applied to the empirical analyses described in Chapter 4. Chapters 4, 5 and 6 discussed these empirical studies and their contribution; Chapter 7 shows how these studies contributed to meeting the research objectives.

With respect to the first objective, the elements constituting DPI were described and evaluated in Chapter 4. Study 1 aimed to provide an understanding of designers' characteristics by investigating the elements comprising DPI in the current design literature. The DPI elements identified were categorized as: Personal Attributes (PA) and Design Skills (DS) (see Figure 3). Furthermore, the meanings and possible relations between each DPI element were set within a cohesive framework. The proposed framework should provide a basis for further work on DPI and a first step towards theory building. The empirical data presented in Chapters 5 and 6, suggest a general recognition of all the DPI elements identified and progressive situational awareness over time. In particular, Chapter 6 describes how respondents recognized the DPI elements and mentioned them spontaneously during the interviews, and before they were introduced to them. A funnel approach was used to validate the elements from literature (Chapter 4). The results further validate the DPI elements identified; they emerged in participants' explanations of the role of the DPI elements in various design practices. Table 20 clarified the list of DPI elements studied in each chapter of this thesis i.e., distilled from literature in Study 1 (Chapter 4), empirically assessed in Study 2 (Chapter 5), and validated from the interviews in Study 3 (Chapter 6), which also provided additional possibilities for new DPI elements.

The table highlights that two PA elements were not included as part of the assessment in Study 2 and modified in Study 3. The two PA elements Creativity (CR) and Empathy (EP) were considered inadequate to be assessed through the developed survey once many other optimized methods can be found in literature as being used for these assessments (e.g., Ho, Ma, & Lee, 2011; Snider, Culley, & Dekoninck, 2013). Furthermore, in Study 2, Motivation (MO*) was also not part of the psychometric assessment and the insights regarding this element were rather prevenient from the qualitative assessment from the open-ended questions. In Study 3, the CO was explicitly divided in two meanings and studied as two independent aspects: Confidence at work (CO) and Self-Confidence (SC). This separation had the intention to create depth to the understanding of this specific DPI element and reduce meaning ambiguity during the interviews. Finally, some examples of new elements extracted from the interview responses was also added to Table 20 in order to demonstrate possibilities of further expansion to the list of DPI elements proposed in this thesis. None of the newly found elements were included in the data analysis in Chapter 6, which had the intention to identify and validate the DPI elements from the original framework. Future studies could research the importance and validity of the new suggestions, as well as possible cause-and-effect relation to DPI development.

Table 20. List of DPI elements usage throughout this thesis

	Study 1	Study 2	Study 3
Personal Attributes (PA)	Confidence (CO) *(Self-confidence)*	CO	CO* / SC*
	Creativity (CR)	-	CR
	Emotions (EM)	EM	EM
	Empathy (EP)	-	EP
	Ethics (ET)	ET	ET
	Leadership (LE)	LE	LE
	Motivation (MO)	MO*	MO
	Openness (OP)	OP	OP
	Responsibility (RE)	RE	RE
	Social Abilities (SA)	SA	SA
Design Skills (DS)	Cognitive Abilities (CA)	CA	CA
	Cognitive Strategies (CS)	CS	CS
	Personal Communication (PC)	PC	PC
	Interpersonal Communication (IC)	IC	IC
	Education-based Knowledge (EK)	EK	EK
	Practice-based Knowledge (PK)	PK	PK
	Managerial Competency (MC)	MC	MC
	Project Management (PM)	PM	PM

e.g., New Elements

Curious
(i.e., learning from failure)

Vision
(i.e., visionary)

Passionate
(i.e., deeply engaged)

Questioning
(i.e., keep making questions)

Assertive
(i.e., tackles the client need)

Persistent
(i.e., hard worker / keep going)

Resilient
(i.e., learning from failure)

Harmonic
(i.e., don't disrupt the work environment)

** Modified elements for data collection*

In the case of the second research objective, PA and DS elements were used to evaluate development of DPI and self-identity at different career stages– from the beginning of education in engineering design to professional positioning as a design engineer. Study 2 aimed to investigate DPI development over time based on Education, Awareness, Expectation and Motivation. The study was based on a specifically designed survey to enable quantitative and qualitative cross-sectional comparative analysis. In order to develop a functional quantitative instrument for DPI, Chapter 5 highlights a number of necessary refinements based on the statistical limitations, related to the current assumptions from literature, and based on the impact of social factors related to DPI (see Chapter 5, Section 5.4). For example, Chapter 5 shows that the designer's self-perceptions are situated and susceptible to change over time. It proposes an initial research framework and operationalization of measures to assess DPI elements cross-sectionally and also highlights some opportunities for future research. The quantitative measures provide inconclusive results and do not add to our understanding of the role of the DPI elements in design engineering. The qualitative evaluations indicate the development of self-awareness and DPI during higher education, with a critical shift occurring with the transition to a professional. Other qualitative measures provide some initial insights into what cases students to choose or to drop out of a design engineering career, such as lack of jobs in the market at the time of graduation. Thus, the qualitative part of Chapter 5 suggests a critical link between DPI perception and relationship to the context. Chapter 6 provided evidence that DPI development is influenced by other factors (e.g., dynamics of adaptation, belongingness and self-perception in relation to the 'other') in addition to pursuit of competency. These findings are in line with the findings in Dent & Whitehead (2001, p. 11), who emphasize identity as being a construct determined by external relations. In this study, we identified some of these external relations such as social-perceptions and contextual factors. Thus, although the quantitative analysis yielded little

new knowledge, the combined results from the studies in Chapters 5 and 6 extend and refine our understanding of DPI development, which fulfils Objective 2) and suggests directions for further work in this area.

In the case of the third objective, the different understanding and perceptions linked to internal and external sources, were evaluated in relation to the analysis of DPI in Chapter 6. Study 3 was aimed at understanding the differences in self- and social-perceptions of the designer's role, and the DPI elements, based on the evaluations of professors, design managers and designers. Differences in social-perceptions in the education and professional environments were investigated. It seems that the situational self-perceptions of designers at the professional level are based on adaptation to balance external and internal influences (see Figure 11). Designers take account of their educational background and the requirements of their practical work, in the quest for professionalism and recognition. The results in Chapter 6 meet objective c) and extend the literature on how social- and self-perceptions regarding the designer's role and PI diverge, influencing DPI in distinct ways depending on the context. This work adds to some of the core literature (e.g., Jørgensen & Brodersen, 2011; Norlyk, 2016; Tracey & Hutchinson, 2013, 2016).

Thus, although PA and other personal-related and contextual factors (e.g., biography, culture, environment, mind-set) are not the main focus in many studies of professional and expertise development, in design these aspects play a major role in relation to design practice and a design career (Smith, 2015b). Development of professional behaviours is related to a learning process (Dall'Alba, 2009), memory and knowledge, which constantly and dynamically reorganize in order to process current design experiences (Oxman, 1990). Consequently, PA should be considered an important part of professional development along with DS. Analysis of the development of the DPI elements resulted in a unique map of interactions for each professional adapted to their level of expertise (Cross 2004; Lawson & Dorst 2009). The intertwined elements captured by this mapping cannot be separated from one another. Thus, all of the elements of DPI develop through experience and prior experience can contribute simultaneously to PA and DS (Helfat & Martin, 2015). However, each stream of DPI elements can be accessed in order to foster professional development and improve managerial competency. Littlejohn (2011) proposes a framework for PI development through education curricula, using the elements of a disciplinary matrix characterizing the design community (e.g., generalizations, commitments, values, exemplars) and reflecting on the construction and mediating process of professional perception and meaning. Thus, although the mechanisms that allow contextual and personal-related factors to influence PI development, these factors are assumed to have a major effect on how DPI evolves. Further work is needed to clarify the impact of external factors on DPI.

The empirical chapters show progression in our understanding of the role of DPI elements in design and lead to a process of theory building (Cash, 2018) (Chapters 4-6). Chapter 4 integrates/synthesizes previously fragmented descriptions of DPI elements and developments, and conceptualizes in the context of designers' characteristics. The elements derived from the design literature reviewed in Chapter 4 can be understood as designers' social-perception of design characteristics and capabilities. Chapter 5 applies this framework to explain the development over time of these characteristics and to illustrate aspects related to a design career based on self-perceptions. Chapter 6 starts with an exploration of the basis of these different social influences and

describes some major differences between the perceptions of professors and design managers. These findings extend the state of the art of the literature on DPI, by providing a holistic overview of designer characteristics and perceptions in the work and education contexts. This holistic approach is fundamental to understanding professional identity and its complexities (Baumeister & Muraven, 1996; Skorikov & Vondracek, 2011).

This study of design professionals links to and has synergies with several other fields. The context of design involves human behaviour and education, and the connections between design engineering practice, design education and design research, psychology, and management and human resources. The psychological aspects regulating identity formation (social- and self-perception), and development of DPI in the education and work environment, add to our knowledge on designers' professional development. This can be used to develop management, mentoring and career guidance tools based on designers' individuality and identity in practice. Figure 12 illustrates the areas of synergy and the interactions studied in this thesis. These synergies rest on an understanding of the elements comprising DPI, namely PA and DS.

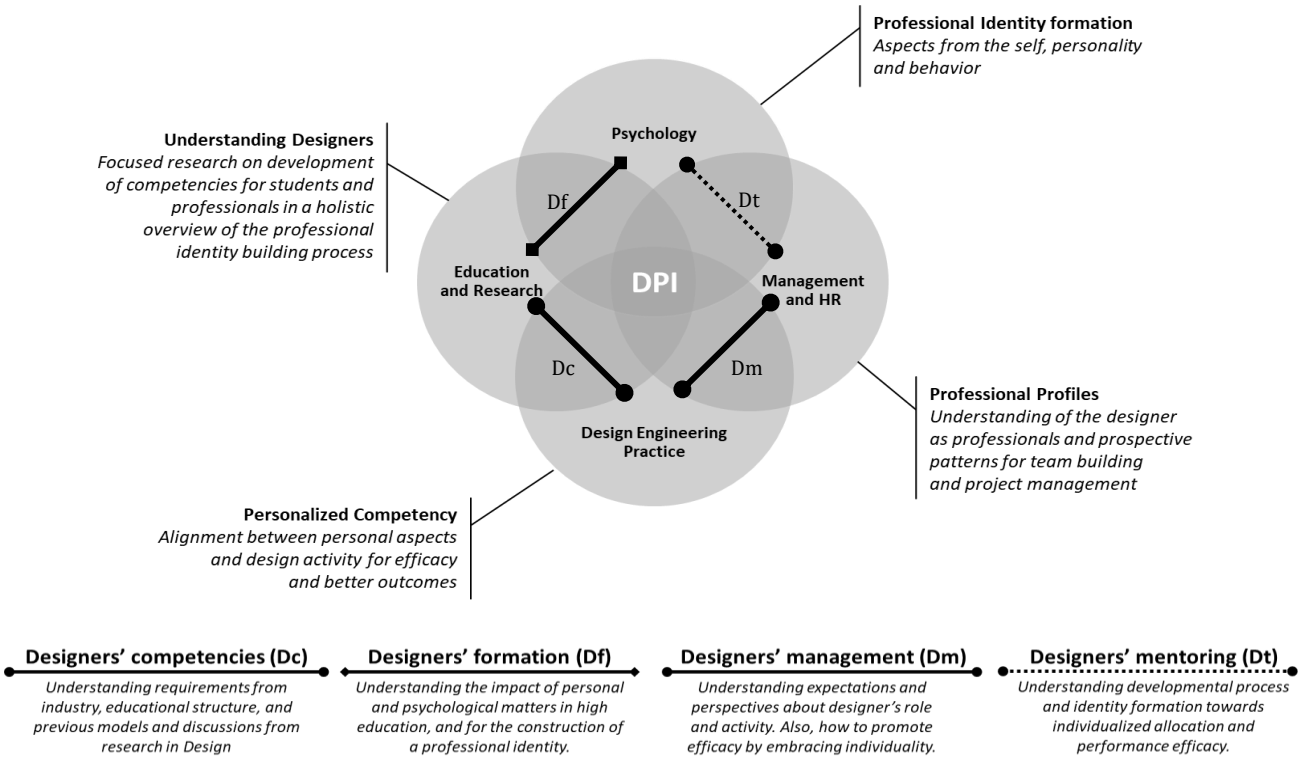


Figure 12. Synergies between different areas of contribution

Each of these synergies contribute to current knowledge regarding DPI in design engineering and suggests areas for further study. Designers' characteristics are the focus of Chapter 4, but are discussed in other parts of the thesis in relation to the DPI elements of PA and DS. The results of this thesis research add to work on competencies and professionalism related to design (e.g., NEDO, 1993; Robinson et al., 2005; Yang et al., 2005a). Designers' formation was discussed in Chapter 5, based on an evaluation DPI elements development and the motivations and expectations related to a design career. The findings extend the current knowledge on design career maintenance and

development by providing a lens through which to study design expertise, taking account of its accumulation over time (e.g., Cross, 2010; Etela, 2000; Lawson & Dorst, 2009; Newing, Waal, & Steele, 2012; Smith, 2015a; Zhang, 2015). Designer management (Dm) and designer mentoring (Dt) were discussed in Chapter 6 as part of an investigation and comparison of the approaches and understandings of professors and design managers regarding the designer's professional role. These results reveal that the successful professional designer is able to adapt to different contexts, balancing the principles derived from education with the requirements of the job market. This contributes to work on design engineering education (e.g., McLaren & Stables, 2008; Mulder, Swaak, & Kessels, 2004; Passow & Passow, 2017; Pearce et al., 2014).

The DPI elements described in Chapter 4 and studied in the chapters of this thesis can be categorized as: 1) **Cognition,** i.e., memory, learning and thinking processes related to design tasks; 2) **Communication,** i.e., networking and interrelations among design team, colleagues and peers; and 3) **Knowledge,** i.e., education, and practical and managerial experience in design projects and tasks. These aspects are closely related to the characteristics identified in the design expertise literature (e.g., Cross, 2010; Dorst & Reymen, 2004; Golja & Schaverien, 2007; Lawson & Dorst, 2005). The DPI element categories add to our understanding of designers. Figure 13 represents a proposed DPI framework in which the intersection/interaction between the designer's PA and DS promotes development of DPI and its intertwined DPI elements, and shapes PI development throughout the design career, through personal experience in the specific culture, work and learning opportunities context and personal experiences.

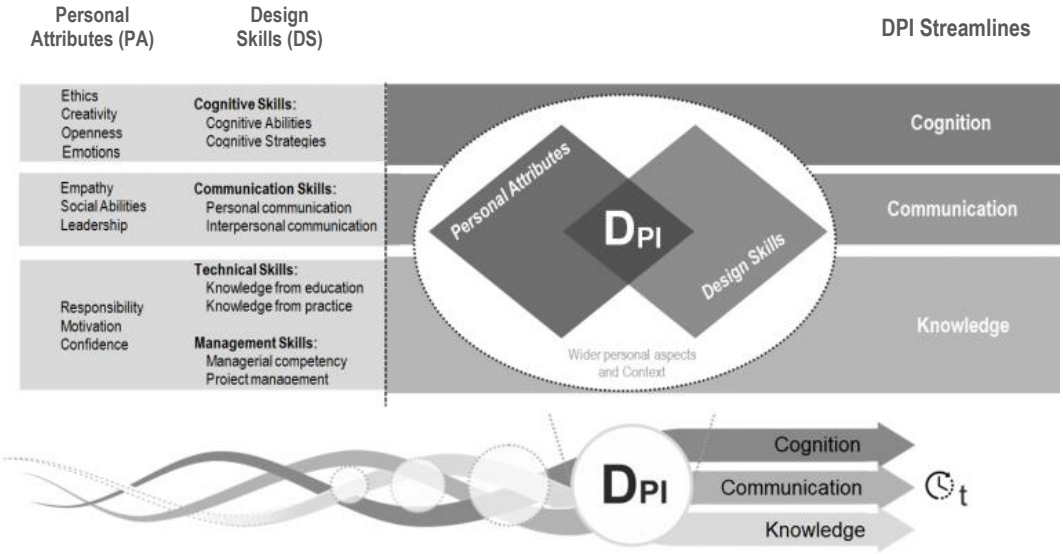


Figure 13. Framework of DPI development

To add another layer to our understanding of DPI, we suggest a developmental process based on the designer's ability to articulate dynamic changes to (1) reasoning and mind-set, (2) knowledge gain, and (3) professional networking related to the construction of a PI over time. In this case, the development of expertise is promoted by a feeling of comfort and integration in the field, as the result of education and practical experience, "which goes together with a feeling of confidence, self-efficacy and PI" (Mulder, 2014: p 111). By focusing on the individual aspects of the designer as an individual

and so as a trained professional, DPI can be understood as the dynamics of the relations between the elements within a particular context, and as changing and developing over time (see Chapter 5). In this sense, the results in Chapter 6 suggest that the external factors identified can influence professional development; we included these in our framework (Daalhuizen et al., 2014; Golja & Schaverien, 2007; Gulari, 2015; Littlejohn, 2017; Smith, 2015b).

To conclude, it is hoped that contribution made by this thesis will be relevant to different designers: i) for **Students**, it could provide a starting point for reflective thinking about self-identification, the foundational understanding of design and their preferred role in the profession; ii) for **Professionals**, it could promote reflection on earlier expectations, knowledge and career development, in the context of their current professional role; iii) for **Educators**, it offers a framework to identify effective teaching, learning and immersion through an identity work process; iv) for **Managers**, it could allow a better understanding of designer identity and its empathic and innovative potential.

A deeper understanding of the process of DPI development reveals new frontiers in design research and contributes to: a) **Designer's Professionalism:** by providing a better understanding of the designer identity, it could provide a more cohesive and structured perception of the professional activity; b) **Management** and **Human Resources** choices in the **Job market:** it should contribute to new career guidance and a balance between characteristics and expectations; c) **Educational aspects:** it allows the curriculum and teaching methods to be adapted for more efficient learning.

The results of this thesis provide some insights into the development of research, education and industry. The insights are drawn from the discussions in Chapters 5 and 6. The "need for alignment" between awareness and expectations (discussed in Chapter 5), and between education and industry requirements and perceptions (discussed in Chapter 6) are intended to reduce the transition crisis that could undermine development of a design engineering career and lead to drop out (discussed in Chapter 2). These aspects are not seen as undermining creativity in design, but rather as fostering a strong PI via positive career progression and a sense of professional belonging. The implications for research, design education and the design industry are highlighted below.

Insights for research

The studies included in this thesis contribute to a process of theory building regarding development of DPI, and provide:

- an understanding of designer characteristics and DPI elements *(e.g., compilation of the PA and DS elements presented in Chapter 4);*
- an initial operationalization of DPI elements as measures of DPI development over time *(e.g., development and evaluation of DPI based on the survey responses, presented in Chapter 5);*
- an understanding of the differences between self- and social-perceptions *(e.g., identification of perceptive differences between designers, professors and design managers, presented in Chapter 6).*

Insights for design education

Based on the results presented in this thesis, design education can foster DPI and facilitate the transition from education to the professional environment, mitigate career uncertainty and professional drop-out. This work provides:

- suggestions for developing individual evaluations of DPI, career guidance, mentoring and counselling to ease professional uncertainty and allow performance improvements *(e.g., the reflection on and awareness of DPI elements and alignment to self- and social-expectations, presented in Chapter 5);*
- support for formal education in design and efforts towards constructing a professional mind-set and aligning skills to the requirements of the job market, and emphasizing the need for alignment between professional expectations and goals *(e.g., the importance of an alignment between self-perception and expectations and identification of the different approaches of professors and managers, presented in Chapters 5 and 6);*
- an initial understanding of the impact of personal and psychological aspects that contribute to professional self-identification and can be developed in higher-education *(e.g., the influence of professors on the construction of DPI, presented in Chapter 6).*

Insights for industry

The work contributes to understanding of PI in design, which develops strongly in the practical and professional environment. The findings suggest that:

- training to encourage confidence and professional values is acquired through formal training of capabilities in terms of developmental human resources. *(e.g., the development of PA and DS elements, as presented in chapter 4)*
- the alignment of values and mind-sets, and an of the expectations and perspectives related to the designer role and design activity, can promote efficacy and mental health, and foster innovation based on individuality *(e.g., the result of self-perception as an adaptation to the work environment, and the importance of aligning perception and expectations, discussed in Chapters 5 and 6);*
- managerial approaches and practices are factors that can foster or mitigate professional identification, especially in young designers *(e.g., the influence of design managers on DPI development, discussed in Chapter 6).*

8. Limitations and further research

Chapter 4 suggests that, DPI theory is an emerging area of study in the design literature. Thus, the methods proposed in this work are exploratory. This imposes some limitations and suggests directions for further research.

In the case of Objective 1), Chapter 4 provides a baseline categorization of PA and DS elements, drawn from a review of the literature. The empirical assessment of these constructs is limited by their broad conceptualization and the range of individual meaning attributions. This resulted in the integration of complex constructs (sometimes bridging disparate study areas) within a unified model to provide

a holistic understanding of the phenomenon of DPI. The operationalization of DPI elements as measures needs further refinement, as discussed in Chapter 5. Alternative methods for the operationalization and evaluation of ill-defined constructs exploits fuzzy set assessment techniques (e.g., Álvarez et al., 2015; Zadeh, 1965), which allows consideration of individual respondents' perceptions. Similarly, Chapter 6 suggests that future work could account for respondents' situational awareness in relation to their environment, social relations (network, peers, and hierarchical structures) and level of expertise or professional development. Further qualitative work could explore the attribution of meanings to the constructs evaluated, and explain some possible misconceptions of DPI elements. Furthermore, a future refinement of the DPI Framework proposed in Chapter 4 could consider the analysis of DPI elements if constituting a pre-requisite or a consequence of the development of a sense of identity in design i.e., DPI. This analysis would help to develop the framework as a supportive tool for DPI development and to assess pragmatic consequences of professionalization and identity in design field.

Regarding Objective 2), Chapter 5 provides a first operationalization of DPI elements as quantitative measures. However, social factors and external interactions that might influence professional self-identification were beyond the scope of this evaluation. This limitation is highlighted by the results in Chapter 6 on contextual factors such as differences in approaches and perceptions that contribute to the adaptation of DPI, reflecting changes in awareness and self-identification. Further work could undertake longitudinal analysis of the development of DPI, controlling for changes in awareness over time and external influences such as situational context, social relations, increased recognition and expertise development. A cross-sectional study was chosen based on the sample type and the strength of the theory, and the lack of previous evaluations of DPI to allow comparison. According to Rindfleisch et al. (2008), cross-sectional data are most appropriate for studies employing samples of higher-educated respondents, employing a diverse array of measurement formats and scales, examining concrete and externally-oriented constructs and which are either descriptive or strongly rooted in theory. A longitudinal approach is more suited to studying phenomena whose temporal nature is clear and it is unlikely that intervening events could confound any follow-up study or alternative explanations are likely and cannot be controlled for using a cross-sectional approach. A longitudinal ethnographic study would provide a qualitative picture of the challenges and transitions that contribute to the dynamics of DPI development. Further evaluations could aim at a combined approach and pre-evaluation of the arguments to maximize the validity of the approach and employing a combination of strong theory, refined survey design and appropriate statistical tools. Future studies also could explore the effects of PI development on behavioural outcomes and professional performance.

Regarding Objective 3), Chapter 6 identifies differences in the perceptions of professors and design managers, and designers' self-perceptions. However, other sources of external perceptions in terms of professionalism influence the development of DPI such as family judgment and support, peer-recognition and individual psychological aspects. Thus, further work could explore the factors influencing DPI based on network analysis and probabilistic predictors. Future work could employ external and personal measures to evaluate situational self-awareness related to professionalism and taking account of the Dunning–Kruger effect on the respondents (Kruger & Dunning, 1999). Finally, the results in Chapter 6 could form the basis for further quantitative evaluation of the differences in perspectives across the various groups of respondents.

Overall, the body of knowledge underpinning this research combines work in psychology and professional identity. The design literature and work on design expertise provide some fundamental understanding of specific aspects and developments in the design profession. Finally, could explore specific educational aspects related to design and propose some guidelines for DPI development through teaching and learning criteria. Furthermore, future research can focus on the comparative analysis of DPI framework to established education frameworks in engineering such as CDIO Syllabus (Crawley et al., 2011; Hoffmann, Jørgensen, & Christensen, 2011; Jørgensen, 2007) or VITAE, in order to provide deeper insights for education and career mentoring in Design.

9. Conclusions

The objective of this thesis research was to improve our understanding of designer characteristics and the elements comprising PI in the context of design, its development and the differences between self- and social-perceptions. The study leads to the understanding of composition, development, and perceptions related to what constitutes DPI. Based on the three studies presented in this thesis (Chapters 4-6), the overall aims are: a) to identify the contribution of these elements to DPI, based on the mapping of the descriptions in the design literature; b) to understand DPI development over time based on the aspects of education, awareness, expectation and motivation; c) to understand the differences in self- and social-perceptions about the designer's role and the DPI elements. This work suggests several implications for future work in the field.

First, the general DPI elements distilled from design literature in Chapter 4 were confirmed by the respondents and described in Chapters 5 and 6 and support the importance of the elements identified in the literature and the need for their further refinement as DPI measures. Second, a new operationalization of DPI measures in the context of design, could build on the recommendations provided in Chapter 5. Chapter 5 also highlights that psychological and situational aspects are interrelated in professional perception and self-identification as a designer. This provides a new perspective on the psychological aspects related to the study of design professionals. Future work could explore the dynamics of psychological aspects such as alignment between career motivation and expectations, and perceptions related to professional identification, mental health and career development. Finally, there are several contextual factors that contribute to situational awareness and self-identification and their adaptation over time, supporting the importance of the evaluation of the social influences on DPI and the need for a better understanding of these contextual factors (see Chapter 6). Further work could provide a more refined understanding of the social and contextual factors related to the professional designer role and developmental expectations, and how these could be better assessed quantitatively.

To conclude this thesis, the three studies conducted in this research provide substantial insights into the stated research aims: they provide a better understanding of designers' characteristics and the elements comprising PI in the context of design, its development, and the differences between self- and social-perceptions. This work combines various literatures and provides both a conceptual and empirical contribution to design research. In tackling some of the problems related to this research, we have identified important gaps in the current empirical approaches and recommendations for further work. This thesis contributes to current research on DPI and advances our understanding of the factors involved in PI in design. It should provide a foundation for future work in this area.

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Annex

1. Designer's Identity: Personal Attributes and Design Skills

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DESIGNER'S IDENTITY: PERSONAL ATTRIBUTES AND DESIGN SKILLS

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Keywords: designer, identity, personality, skills, competencies

1. Introduction

A designer's identity combines the fundamental characteristics that comprise their personal and professional attributes. Holistically understanding a designer's personality traits, skills and competencies enables the development of more effective design process, as well as supporting the development of an individual's self-perception as a designer. This paper brings together the previously disparate literature on personal attributes and developed competencies in order to describe a holistic professional identity framework for designers.

The term 'design' describes a range of different professionals and activities, with a mix of knowledge areas, including engineering, architecture, and industrial or graphic design. However, these professions all share elements of problem solving required for design activity, and the multidisciplinary aspect of design synthesis. Therefore, important questions are 'Who are these professionals called designers?', 'How do they develop their professional identity?' and 'What is expected of them?'

Designer's identity is built during their development through both formal academic learning and professional experience, empowering their personality traits and the native skills of planning and creation [Dong 2010]. In the wider context, this professional identity, together with an individual's personality and experience, drives their response to external stimuli and hence their behavior in a given situation. Further, the interaction between these elements over time drive the evolution of both the professional and personal identity constructs. Thus, understanding how a designer's professional identity forms and subsequently evolves are key to understanding and managing design behavior.

Professional and personal identity are not static [Baumeister and Muraven 1996], [Ahlgren and Tett 2010], which results in three major challenges in relation to the design literature. First, there is a need to bring together the multidisciplinary aspects of design [Menon 2015] with the different specific focus areas encountered during design work in order to describe the personality attributes associated with design competencies. Second, the design identity has been discussed through a number of disparate works on competencies/skills improvement directed towards work needs (e.g. [Crain and Davis 1995], [Yang et al. 2005]), and not holistically as designer self-development. Thus, there is a need to bring these aspects together into a single cohesive framework. Third, as learning is a holistic process of adaptation to the world and not just the result of cognition [Dermikan and Osman Demirbaş 2008], there is a need to develop an integrated understanding of the way the total person thinks, feels, perceive, and behave [Kolb 2005], [Adams et al. 2011]. As such, there is a need to develop a holistic framework integrating both the personality and skills perspectives on designer's identity in order to answer the RQs: What is described in the current Design Literature as fundamental Personal Attributes (PA) and Design Skills (DS)? and How are these elements related to the Designer's Professional Identity (DPI)?

This paper proposes a conceptual framework that brings together a holistic description of designer's identity, in order to set the stage for exploration of its development over time. This is based on a

systematic literature review of key design journals over the last twenty years, which provides through different discussions the main elements widely understood as necessary for design. A subsequent narrative review was then used to add literature from the wider Design, Management, and Psychology fields. This is used to develop the understanding of the relations between the identified designer identity aspects and the identity building process: PA and context; specific knowledge and skills development; and the influence of Design Thinking and social issues.

2. Methodology

In order to create a holistic framework describing designer's identity, we examined the attributes described as essential for an individual be consider a designer, as found in the design literature. A systematic literature review was developed in order to map these skills and personality traits. The initial review described in this paper considered articles published in Design Studies during the period 1996 - 2015. Design Studies was selected for this research as it is one of the main design journals dealing with multidisciplinary studies of designers. Based on a prior narrative literature review, 12 terms (words and expressions) were selected as representative of professional characteristics and required skills within the design field. Table 1 shows the terms used to search in title, keywords or abstract of papers available through ScienceDirect.

Table 1. Searched terms (title, keywords or abstracts)

"Identity" / "Identity Formation"	"Competenc*"	"Personality"
"Self"	"Self-Construal"	"Self-Development"
"Design Profession"	"Learning Process"	"Skills"
"Expertise"	"Expertise in Design"	"Expertise Development"

The review resulted in a total of 81 articles retrieved from Design Studies. The pertinent studies were selected, resulting in 21 papers included in the final review. Data was categorized as either related to PA or developed skills. Each category was sub-categorized, and the number of publications refers to different papers citing the same attribute. The number of papers that cite an attribute is considered to measure the amount of discussion dedicated to a specific characteristic of the design profession, and so the attention given to this topic in the design research field. However, this score is not a measure of the importance of certain characteristic with respect to identity formation. For that, further empirical study is needed once the major attributes are identified. Some papers cite more than one attribute, therefore the number of references in Tables 2 and 3 differ from the total number of selected papers. Furthermore, a secondary narrative review was developed through citations and references related to the selected papers. This additional review was used to identify studies from the Psychology and Management fields and different journals and sources were incorporated as knowledge to the discussions sector on this work.

3. Designer's identity

The designer's identity can be understood as a social- and self-perception, built on the synthesis of individual and professional aspects, which enable someone to design. An individual's identity is an adaptation to a sociocultural context. History, culture, and the proximate structure of social relations create a context in which the individual identity must exist [Baumeister and Muraven 1996]. Professional identity (as one context-related part of the whole individual identity) has been conceptualized as a dynamic understanding of the professional responsibilities, actions, beliefs and values through the synthesis of knowledge. It requires not only the acquisition of expertise and skills but also professional ways of being [Dall'Alba 2009] that are directly related to professional development and experience, and recognized through rewards and acknowledgment. In the professional context, this relationship is particularly strong since the career is a record of promotions, honors, and marks of distinction. Thus, work is usually done for the sake of identity-building, such as gaining

advancement and recognition that validate the self [Baumeister and Muraven 1996] and embody our individual characteristics on the act of being a professional [Luehmann 2007], [Dall'Alba 2009].
The definition of identity discussed by Baumeister and Muraven [1996], and the understanding on construction of belongingness [Baumeister and Leary 1995] through learning and skills development, connect these elements of professional identity development to the link between PA and developed skills as described in Sections 3.1 and 3.2. Thus the designer's characteristics must be considered as the union of PA and skills. This holistic view of professional identity is affected by context [Adams and Marshall 1996], thence driving behavior and important design processes such as problem solving [Thomas and Carroll 1979], [Bosma 2001].

3.1 Personal attributes (PA)

PA influence and promote the growth of competencies and, at the same time, the development of a personal self-understanding as a professional – a designers' identity comprehension. The elements from the systematic review that constitute the designer's PA are presented in Table 2. These have been linked to fundamental personality traits. The HEXACO and the BIG FIVE (B5) models of personality are well established in the psychology field [Kichuk and Wiesner 1997], [Brocklebank et al. 2015]. Together these models allow for a cohesive framework in which to bring together the disparate design literature. These were used as a starting point for compiling designer's PA, as there is no extant framework in the design field.

Table 2. Table of personal attributes of designers allocated on the personality traits models

PSYCHOLOGY FIELD (HEXACO model and B5 personality traits)	DESIGN FIELD (Elements from the Design Studies Review)	
	Categories	No. Pub.
Honesty-Humility (H)	Ethics and ethical virtues	2
Emotionality (E)	Emotion	1
Extraversion (X)	Social abilities	5
Agreeableness (A)	Leadership	4
Conscientiousness (C)	Responsibility	2
	Motivation	2
Openness to experience (O)	Openness (be open-minded)	5
Neuroticism (N)	Self-confidence	1
	Confident attitudes	6

In the psychology literature, a number of authors (e.g. [McCrae 1992], [Ashton et al. 2004], [Barford et al. 2015]) describe each personality trait and the multiple facets that compound it. The designers' PA that emerged from the review could thus be fitted to the traits. Based on the review it is expected that designers exhibit all the listed abilities to various degrees. However, aspects such as 'emotion' and 'self-confidence', which are consider as key elements of identity and career development in the psychology literature [Bobes et al. 2008], [Larsson et al. 2009], [Lively 2015], are poorly discussed in the design field. These are only mentioned in one paper each (Table 2): Pahl et al. [1999] and Robinson et al. [2005], respectively. Further, the conscientiousness was also found to be poorly represented in the design literature. However, the attributes that emerged in this category, Responsibility and Motivation, are widely discussed as competencies in Management [Manzoor 2011], [Jordan and Audia 2012],

Psychology [Fisher 1978], [Breines and Chen 2012], and studies related to work environment and efficacy [Barrick et al. 2013], [Pe-Than et al. 2014].
The HEXACO Honesty-Humility factor evokes a sense of morality, sincerity, and integrity [Ashton et al. 2004] that links to the Ethics and ethical virtues attributes found in the design literature. Loufrani-Fedida and Missonier [2015] identify Ethics and ethical virtues as one component of a set of 'softer' project management competencies, which become essential in dealing with project complexity. However, only two works were identified as related to this aspect of designer's identity.
Social abilities, Leadership, Openness, and Confident attitudes appear to be the focus of designers' PA and competency development discussion in literature. Social abilities are interpreted as good interpersonal skills [Robinson et al. 2005], team spirit [Yang et al. 2005] and participation [Dong et al. 2013]; and fit the Personality factor Extraversion, which is usually described by the duality: outgoing/energetic vs. solitary/reserved; and brings together traits such as sociability, assertiveness, talkativeness, and activeness [Digman 1990], [Barrick and Mount 1991], [Kichuk and Wiesner 1997].
Leadership emerged as the designer characteristic for Agreeableness, since it deals with the duality: friendly/compassionate vs. analytical/detached. This attribute is often cited as important to managers [Suikki et al. 2006], [Stevenson and Starkweather 2010], [Loufrani-Fedida and Missonier 2015], but in design it's also described by dealing with questions of authority [Dong et al. 2013] and empathy [Cross 1982], [Willem 1990]. Openness to experiences refers to aspects that fit the relation inventive /curious vs. consistent/cautious such as creativity, imagination [Yang et al. 2005], and the ability of dealing with ambiguity and change [Robinson et al. 2005]. The confident attitudes attribute is allocated to the Neuroticism factor, since it deals with the sensitive/nervous vs. secure/confident duality.
From this review it is possible to initially conclude that all the identified attributes are relevant although not all have been widely studied in design, and there are no current frameworks where they have been holistically linked in the design literature. In addition no extant framework brings together both personality and skills perspectives.

3.2 Design skills (DS)

DS usually indicate the set of competencies needed to achieve the goals of a design project. These been described using different terminologies [Crain and Davis 1995]. Most categorizations include e.g. structuring open problems, information gathering, and divergent and convergent thinking.
According to Horváth [2006], functional competencies can be split in two points of view: reductionist and holistic. In the reductionist view, design competence is considered to only be a set of low level competencies e.g. drawing skills or spatial vision, which have typically been studied individually. In the holistic view, design competence is a synergetic construct of generic elements i.e. a combination of aspects that together support the capacity to design.
In this paper we used the holistic view to describe an overview of the designers' skills, linking both physical and mental domains, providing a holistic view of the elements that comprise the design competence. Table 3 shows the four main skills categories in which the identified design facet were allocated: Cognitive Skills, Communication Skills, Technical Skills and Management Skills.

Table 3. Table of design skills

DESIGN FIELD (Elements from the Design Studies Review)			
Categories	**Subcategories based on terms found in the review**		**No. Pub.**
Cognitive Skills	Abilities	Understanding	14
		Thinking	
		Evaluating	
		Abstracting	

		Learning	
	Strategies	Problem framing	4
		Problem solution developing	
		Problem solving	
Communication Skills	Personal	Communicates clearly	3
		Communicates directly	
		Attends to details	
		Empathize with audience	
	Interpersonal	Rapport establishment	4
		Collaboration	
	Presentation	Communicates properly	3
		Present properly	
		Language	
		Negotiation	
Technical Skills	Educational-based	Operational	2
		Specific	
	Practice-based	Imagination / representation	4
		IT ability	
		Ability to apply knowledge	
Management Skills	Manager	Generic	3
		Job-related	
	Project Management	Planning	6
		Development	
		Effectiveness	

At its core design builds on a number of cognitive skills that are heavily researched in the design literature [Thomas and Carroll 1979]. These include five main capabilities and three strategies (Table 3).

The five cognitive abilities found in the literature are: understanding, thinking, evaluating, abstracting, and learning, associated with 14 papers. In particular research has focused on cognitive skills such as evaluating and abstracting. Here, evaluation links to importance judgment, task analyses, project factors identification, effective decision making, and process-related choices [Robinson et al. 2005], [Ozkan and Dogan 2013]. Abstracting is based on the capacity to generate and handle abstract concepts [Cross 2004], [Ozkan and Dogan 2013]. The three strategies discussed by the literature all concern the process: problem framing, problem solution development, and problem solving. Here higher levels of

competence across these strategies imply more specific problem solving capability and knowledge [Horváth 2006]. Within each of these skills a wide range of research foci have been identified.
Communication skills are grouped in three levels: personal, interpersonal and presentation. All levels shows similar number of publications but only one paper discussed more than two of these topics simultaneously. Collaboration was the most discussed skill at the Communication category.
Technical skills are represented by two main areas: Educational-based and Practice-based. The main focus of the reviewed literature is on the practice-based area where skills are developed through experience. In contrast educational-based skills development is only discussed in one paper.
Finally, management skills are described on two levels: the manager level and the project management level. These have been discussed in a variety of contexts by authors such as Robinson et al. [2005].
Through the literature review was observed that most of the identified publications in the design field discuss DS, especially cognitive. However, as with the other categories in the wider field of DS it becomes necessary to link these to the other skills categories, as well to the personality traits described in Section 3.1. Thus, as with the PA it is possible to conclude that each individual aspect is relevant, to varying degrees, to designer's identity but that there is a need to link these in a cohesive framework.

4. Designer's identity and its development

Designer's professional identity (DPI) can be understood as the union of all the components identified in Section 3, together with the wider personal construct, all in a sociocultural context. Thus, we assumed that the described PA and DS when brought together with context creates a framework where designer's identity can develop over time, as illustrated in Figure 1. Through this conceptual framework, built from the review results, it can be perceived that the designer as a professional cannot be measured only by one of these sets, rather they must be considered holistically and with respect to the different aspects of their required job, and the wider context.

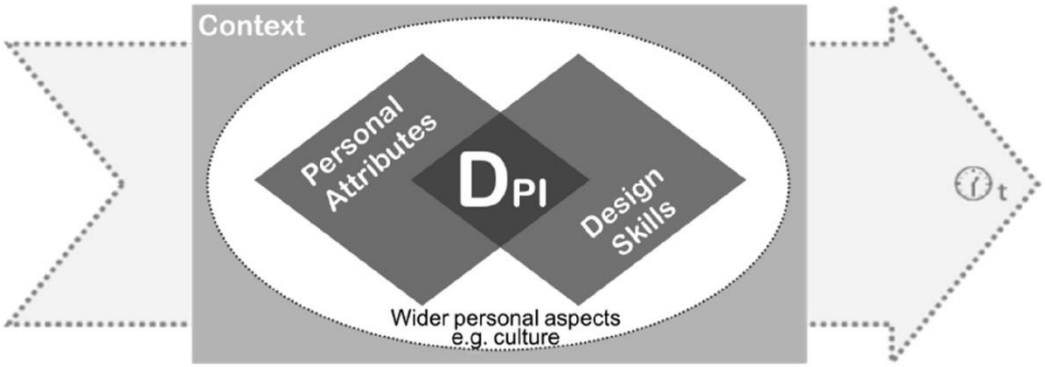

Figure 1. Designer's professional identity formation framework

The methods used to study PA often reveals a tacit assumption of immutability, even though the attributes are a function of the social context and some studies appoint it as susceptible to change by behavioral/concepts internalization [Baumeister and Twenge 2001]. Research suggests that personality changes gradually over years (rather than moment to moment) and in response to changes in contextual elements important to the individual [Roberts et al. 2008], [Brooks et al. 2010]. As such, this aspect can be understood as relatively slowly updating. This is in contrast to DS that evolve substantially over time as consequence of learning activities and through interaction with the environment. These skills refer to the practical knowledge, tools, and abilities that allow a designer to complete the tasks assigned to them; and can be considered as a more dynamic level. Here, the accumulation of knowledge through experience in the skills sphere leads to expertise development over time, then it is no longer specific information but knowledge of "stored experience of the actual outcomes of tens of thousands of situations" [Dreyfus and Dreyfus 2005, p.788]. This leads to a complex non-linear development of expertise, since each aspect of expertise may evolve with some skills more developed than others

[Lawson and Dorst 2009, p.94]. Expertise co-evolves with identity, dealing with context and behavior adaptation, as with PA such self-confidence [Larsson et al. 2009].

4.1 Bringing together personal attributes and context

As outlined in Figure 1 PA are directly related to context in a symbiotic relationship. Context is modified by the behaviors and interactions, since it changes the environment feeding back this circular bond. Figure 2 brings together the diverse PA found in the review together with the wider context. Individual letters are used to represent each attribute and its subcategories, derived from Table 2. The letters encode the PA related to design referring the psychology traits of HEXACO/B5, categories that features two aspects were named individually e.g. Cr (Conscientiousness – responsibility) and Cm (Conscientiousness – motivation). Figure 2 also shows the context levels that impact behavior and the developed of the PA over time.

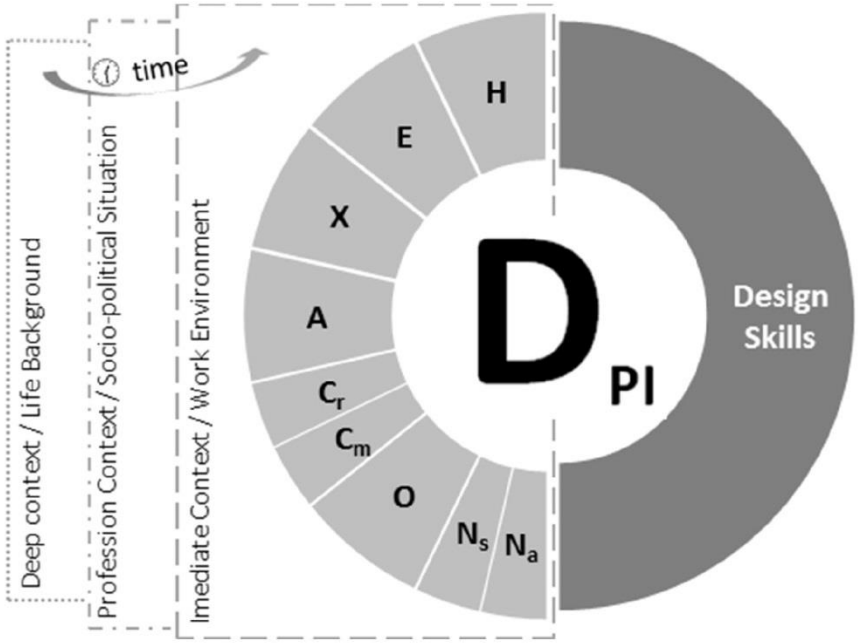

Figure 2. DPI framework: Elements of personal attributes

Three different levels of context were identified as influential with respect to PA: Deep context i.e. individual's background and biological based traits; Professional context, i.e. in a certain period of time within the historical and socio-political situations of the profession; and Immediate context, i.e. the current work situation and environment. These levels also evolve over time and are part of the identity construction process.

At the deep context level reside innate characteristics, genetically derived, and reflectig developed aspects from childhood and adolescence [Adams and Marshall 1996]. In a professional context, questions related to the professional class identification, especially for designers, generate problems of self-understanding as professionals; since they affect the personality development with respect to the personality traits and the behaviors they promote [Baumeister and Muraven 1996], [Downing 2003]. At the immediate context level work environment, stress situation, and self-confidence are some of the aspects related to identity formation; and the combination of built personality, expertise and project pressure situations shape the behavior in each situation [Barrick and Mount 1991].

Levels of context and their impact on personality and identity are well discussed in the psychology literature. However, further development of this discussion in design is out of the scope of this paper and can be better explored in future work.

4.2 Bringing together skills and context

Designer skills (cognition, communication, technical, and management) bring together the four categories discussed disparately throughout the literature as fundamental to designer activity. These categories are mainly developed during education. Figure 3 syntheses the design skill into one framework, linked to context based on Table 3, and also shows the context levels that impact the performance and the acquisition/development of these skills over time.

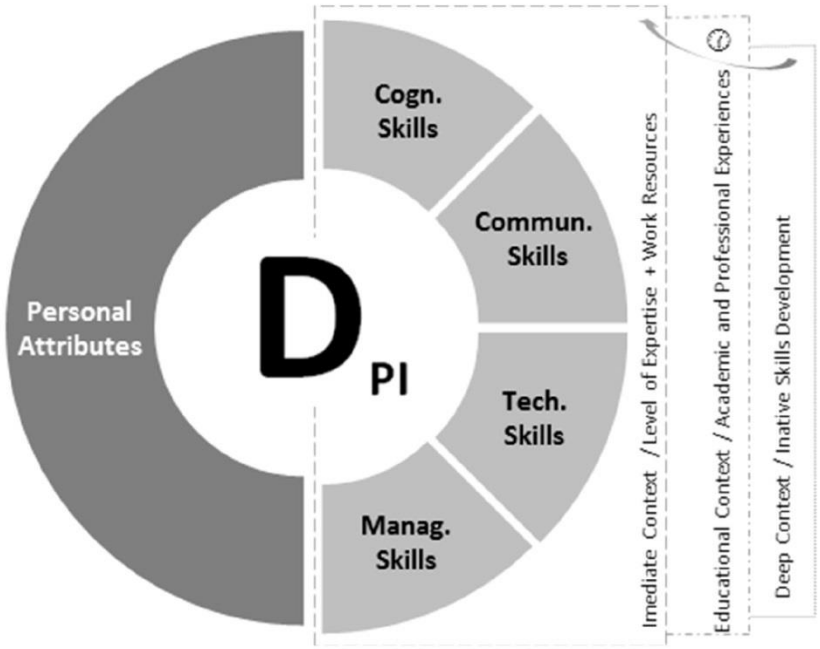

Figure 3. DPI framework: Categories of design skills

The three different levels of context that can influence skills were identified as: Deep context, that represent the past scholar context and developed knowledge, and the innate capacities/talents identified from childhood and adolescence [Downing 2003], [Dong 2010]; Educational context, that brings up the knowledge absorbed and trained during graduation and professional experiences [Cross 1982], [Etela 2000]; and Immediate context, that relates the expertise level, work resources, and actual project requirements [Cross 2004], [Christensen 2006].

In this sense, we assume that varying from each individual some of the competencies discussed on Table 3 may be developed since the early years in a deep context. It evolves and grows through training, through association with new knowledge, and through new skills development during educational years and professional activity. The set of competencies must be balanced within the four skills category in order to achieve a good designer profile. In a certain way, PA are also developed during schooling period and learning process. Since this individual becomes mature and confident, it present impact in all described personality traits and end-up as the described PA showed on the literature as important to designers. Also, the specific knowledge gain and the process of identity formation as a professional don't finish with the studies period. Learning process is lifelong and evolves through professional life during experiences, and self-perception evolution.

For the designer's identity development two ways of specific knowledge of communication are important: technical language skills as visual representation, and specific hall of technical words and terminologies. Differences in context – material and conceptual – also influence the communication [Bucciarelli 2002] and learning process; and together with methods and instruments, codes and rules, and webs of practice, impact on identity.

5. Limitations

The initial review may not have captured every work published in this area, it is believed to be sufficiently comprehensive to provide a strong overview of this subject in design field. Although Some works that have not used the selected keywords but investigate a similar or related subject might be missed.Terms such as "Responsibilities" and "Tasks" were purposely left out of the keyword search since they were understood by the authors as job and context related rather than related to the inner personal level that was the focus of this paper. Finally, additional journals were added to the systematic review in order to extend the scope of the work and improve the framework proposed here.

The presented conceptual framework is based on a literature-review and was developed as the basis for future studies following the classical research process described by Blessing and Chakrabarti [2009]. Due to the fragmented literature, this is a necessary first step before empirical work is possible.

Limitations on the discussion about the impact of different levels of context and its structure were also faced. This paper presents only a brief discussion and, due to the complexity of the topic, suggests for future research the development of focused studies. Deepest exploration on this topic is necessary to provide knowledge for discussing the impact of context on designers' identity formation.

6. Conclusions and implications for further research

A systematic review was used to identify the PA and DS associated with designer's identity. The review was then used as basis for proposing a holistic framework integrating these elements with respect to context and time. Thus, the framework forms the foundation for further exploration that could describe the process of professional identity construction and its relationships.

The intimate relation between the PA and Skills cannot be apart, neither dissociate from the context. All these competencies are also developed over time during professional experiences, and contribute to expertise and specific professional language formation. Expertise is usually treat as a sequence, but "In reality each designer will develop their own unique manner based on their own background, personality, motivation, and opportunity. Each designer will put together their own way of designing" [Lawson and Dorst 2009, p.98].

In the proposed framework, the designer identity construction process occurs integrates PA and DS, and is related to different layers of context, which evolve over time. PA bring together the designer's psychological characteristics linked to established personality traits models. DS are the set of competencies fundamental to design activity accomplishment. In both elements, a wide range of sub categories and research areas were identified. However, no prior works were identified by the authors during the literature review process as bringing all elements together in a single framework. Further, prior studies have tended to focus on individual personality traits such as creativity and specific project-related skills. As such, the proposed holistic framework forms the foundation for bringing together research on DS, personality, and expertise, in order to better understand designer behavior, development, and education.

The proposed framework highlights the intricate nature of designer's identity, offering insights into the importance of identity development and construction not only for the design field but for management, human resources, and education as well. Moreover, this work aims to provide one of the first steps towards a holistic understanding of a designer's personality traits, skills, and competencies in a cohesive framework; that enables their individual self-perception as a designer and leads the understanding and managing of design behavior. The illustrative understanding of designer's professional identity formation also contributes to a full understanding of professional development. This study contributes to developing the link between technical and human aspects of designers' identity formation, and can stimulate developments in: Professional aspects through the understanding of designers' characteristics; Cohesion and structure of the profession itself; Job market for designers through the balance of profile characteristics and expectations; and in Educational aspects through better adapting curriculum and methods for teaching and learning.

Future research can use this framework to explore the relationship between the Designer and, for example, the various levels of context briefly discussed on sections 4.1 and 4.2. The impact of context on designers' identity formation is a complex topic for research and cannot be further discussed without focused study. The process of identity formation over time and its evolution, the relationship between

identity and behavior, and the impact of identity on socialisation/interaction and group dynamics are also interesting topics that can be studied in future work. The complexity related to these relations does not allow discussions of all elements at the same time without prior focused studies in each area. Therefore, studies related with designer's identity broaden the design field and provide opportunities for a number of integrative follow up studies. For example, focused studies could link the elements and address its relations.

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2. Designer's Identity: Development of Personal Attributes and Design Skills over education

21ST INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED17
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DESIGNER'S IDENTITY: DEVELOPMENT OF PERSONAL ATTRIBUTES AND DESIGN SKILLS OVER EDUCATION

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Abstract

Designers' Professional identity (DPI) is a social- and self-perceptive construct through which designers are able to identify themselves. To understand the development of DPI, not just as a profession but also as an educational process, there is a need to consider the designer as both individual and trained professional. These interactions become also a necessary foundation for professionalism that is especially important for design activity. For this study, a psychometric survey was developed by taking in consideration both aspects of DPI, making use of a set of elements distilled from literature as conceptual parameters for Personal Attributes and Design Skills. The survey evaluated professional self-awareness of design students at bachelor and master level; also providing a first profile model of the two groups. The dynamics of the relations between the DPI elements changes and develops very slowly due to the process of identity consolidation over the educational period. Further, DPI consolidates through a lifelong learning process. These results provide an initial insight into the development of DPI and the challenges of measuring this subjective aspect over education.

Keywords: Designer identity, Design education, Human behaviour in design, Knowledge management, Design learning

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1 INTRODUCTION

Professional self-identity is considered a 'state of mind', or an awareness level, on which one can identify him/herself as belonging to a professional group. The formative process of Designers' Professional Identity (DPI) development starts during professional education and continues lifelong, throughout practice (Godsey, 2011). This professional consciousness plays an important role in one's confidence and professional development since it is a core element of personal identity (Skorikov and Vondracek, 2011). Thus, the sense of belonging to a group, and so to a profession, is an integrative part of the self and directly reflects one's development and performance in a work context.

The process through which a designer comes to develop a distinct professional identity has been widely discussed in terms of designerly ways of thinking or as competencies and abilities (Cross, 1982; Adams et al., 2011). Lawson and Dorst (2009) also highlight *"identity"* while discussing expertise in design, questioning the "something more" that could compose design learning rather than just skills acquisition. The development of a professional identity is affected by social, demographic, and personality factors (Crossley and Vivekananda-Schmidt, 2009), requiring the integration of one's personal values, morals and attributes with the norms of the profession (Cowin et al., 2013) and technical knowledge. Thus, although a few studies already discuss aspects of personality, the link between the psychological dimension and the development of skills in design is still little described (Kunrath et al., 2016). As such, there is a need for an investigation that integrates personal aspects and required skills as variables of professional identity, which underpin the processes of self-identification as a designer.

This paper takes the first step towards this understanding by answering the RQs: 1) Are students' self-awareness of Personal Attributes and Design Skills aligned with the Design literature? 2) How does the professional identity evolve over the course of education? The long-term objective of this research is the creation of a model of designer's identity formation process. Thus, specific implications for further research are also described.

This paper presents the data from a psychometric survey study and provides the first insight into the development process over an education in design. Results are discussed based on the first descriptive statistical analysis of the elements obtained by this study, and their significance is explained in the context of a proposed holistic model of designer identity.

2 LITERATURE REVIEW

The study of professional identity development covers many fields of research and practice. It has deep roots in psychology studies that discuss aspects of the self and identity in many branches on which personal development and occupational identity interact (e.g. Schwartz et al., 2011). However, research on identity is also found in Management and Human Resources, where work environment and professional satisfaction shape improvements in competence and performance on many levels (e.g. Ashcraft, 2013). In the same sense, research on Professional Development and best practices in Design can provide a deeper understanding about professional designers, due to the evaluation of several aspects and in a context, in order to better adapt the individuals to the challenges of the field by guidance (Evetts, 2003; Tracey and Hutchinson, 2013). While the elements that characterize professionals are discussed, modeled and improved in a broad scope of literature in other research fields (such as in health care management), this topic is still underexplored when considering the unique set of characteristics and environment in which design professionals are immersed.

To identify and map the elements considered to be important personal attributes and design skills, a systematic literature review was conducted in a prior study by Kunrath et al. (2016). From this review, elements considered as being important or required for designers and design activity were distilled from the literature. Further, the list of elements was categorized as either related to Personal Attributes or Design Skills. As such, this paper builds on this review as the foundation for the survey described in Section 3.

The elements classified as Personal Attributes are those that describe the designer's characteristics related to psychological aspects i.e emotions, feelings, attitudes and behavior. Hence, they are not related to technical abilities but rather to the inner state of socio-psychological and values-based comfort in which one feels (Tam et al., 2008). Further, they are externally expressed through being a designer and in the relation between mind and body turned into attitudes (Dall'Alba, 2009). Due to its psychological nature, Personal Attributes also relate to personality and personal behavioral approach, which are known

for relying on temporal consistency, changing very slowly and gradually over time (Brooks et al., 2010). In this sense, a slow development of the Personal Attributes' set of characteristics is also expected while measuring DPI. Note that, by Personal Attributes, we do not refer to personal aspects that can be easily trained within the professional education and training, i.e attributes of internalized erudition and skills of a certain profession that a person possesses (Cowin et al., 2013). Rather, Personal Attributes aligns with e.g. character, values and their expression.

The elements classified as Design Skills are those that describe cognitive, technical and behavioral characteristics related to the specific practice of design activity. These elements compound the set of skills necessary to successfully develop a design process, and are not specifically related with the designer itself. Rather, they are characteristics that can be directly trained within the educational and practical contexts (Horváth, 2006). This set of competencies develops more rapidly due to formal learning processes, since higher education is meant to align expectations between industry and professional education in order to increase employability (Jackson, 2014).

The undergraduate period is usually an uncertain stage of life in which a student fits into the category of *Occupational Identity Moratorium,* described in Psychology as "an active process of exploration and crisis and temporary inability to make a lasting career commitment" (Skorikov and Vondracek, 2011). This kind of uncertain self-concept shaping might extend throughout the educational period, impacting on the transition from student to a professional level, and reinforcing the importance of professional assistance in career commitment and development. It is expected that no higher professional identity development would be happening during the student phase of life, while design students are slowly shaping their overall identities, and with little or no immersion in practice. However, the understanding of this transitional process allows the development of stronger and effective guidance through higher education, helping to shape confidence in the students' professional knowledge and skills (Zou and Chan, 2016).

Thus, the union of personal and technical attributes provides a holistic overview of Designers' Professional Identity (Kunrath et al., 2016). Furthermore, the DPI elements guide and influence all decisions that are taken within a design project such as the designer's behavior within the work environment, project team interactions, and design process progression (Adams et al., 2011). Together, Design Skills and Personal Attributes establish a substantial amount of interconnections that allows the development of the Designers' Professional Identity lifelong, based on an ongoing construction of self- and social perception as being a designer. The elements that compound this understanding set the path of becoming a designer, providing marks on which thinking, feeling, perceiving, behaving, and being a designer are based (Kolb et al., 2013; Dall'Alba, 2009; Adams et al., 2011). This study brings together the elements from both Personal Attributes and Design Skills and provides the first measurement of these elements among design students, by comparing bachelors and masters in order to identify differences and trends of development.

3 METHODOLOGY

The present study employs a cross-sectional questionnaire-based survey methodology to collect information from two levels of expertise in design: bachelor and master students graduated within the Design & Innovation (D&I) program at DTU - Technical University of Denmark. The data gathering was done applying a self-administered online questionnaire, using the Qualtrics platform, as a psychometric test with a duration time of around 20 minutes. The participant students were accessed during the autumn semester of 2016. The surveyed Population (N) is compounded by two clusters: bachelor students (240) and master students (188). Of these 248 design students, 104 bachelor students and 79 master students agreed to participate in the study, in a sample fraction of 42% and 43% respectively. The average response rate of the survey participants was 83% for bachelors and 63% for masters for all the questions.

The test allowed the respondents to say how much he or she identified with pre-set self-statements related to elements of design, examined in two dimensions: i) Personal Attributes Measures, where specific questions were used to investigate designerly traits previously identified in the literature; ii) Design Skills Measures, where personal constructs about skills and career development are elicited. Thus, the survey provides a holistic map of a designer at different levels of professional education by sampling the beginning and final stage of the educational process.

3.1 Survey and Measures

In developing this survey, we built on the elements identified in a previous systematic literature review of the design field (Kunrath et al., 2016), as discussed in Section 2. As a second step, the survey's Likert-type scale items were developed in order to match the design field context. The development of items specifically for this study was required since no previous model or set of survey items could be found addressing the specific focus in design.

The process of survey development involved careful instrument design, with particular attention paid to question wording. Therefore, item choice, revision, and writing were guided by prior definitions of each construct in the design literature. When creating new statements several principles were used in order to write items that (a) reflected the construct definition, (b) were distinct from the other identified characteristics; (c) did not exceed a maximum length (20 words); (c) did not have an explicit measurement meaning. These principles also follow Robson and McCartan (2011) and Rust and Golombok (2009) suggestions for designing self-completion questionnaires. The developed items were then piloted on a test population. Based on this, changes were made to improve the measures or otherwise to clarify the items. Table 1 illustrates, as an example, the model of items used for one of the measured elements and also the sentences associated with its element. The questionnaire is comprised of 50% positively-keyed sentences and 50% negatively-keyed sentences (referring to the opposite relation/meaning of the intent measurement) in order to reduce the effect of acquiescence bias (Furr and Bacharach, 2013).

Table 1. Example of element's items developed and used on the survey

Element	Items (self-reflective sentences)	Relation
ETHICS	I consider environmental and social aspects when designing	+
	I am interested in the entire chain that supports my product development	+
	I always aware my client if the idea can have possible negative consequences	+
	I prefer to design beautiful and valuable things	-
	For me, design is all about aesthetic expression	-
	I don't mind about the laws when designing	-

A simple response scale measurement was used in this survey, in order to make answering faster and the understanding of the items easier (Morgeson and Humphrey, 2006). The use of a multi-item scale was necessary due to the expected small sample size, in order to measure weak effect within each category. Also, complex response scales have been shown to add substantial amounts of construct-irrelevant variance (Harvey et al., 1985). As such, all items used a 5-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree) with no neutral option in between. Rather, we inserted a point valued as zero "I don't know" on the right position of the scale. This point is not included in the metrics but allowed the respondent to inform us if they did not understand the question, did not have an opinion, or did not know the answer, without compromising the positioning on the valid points. As addressed by Rust and Golombok (2009), the use of a scale with no middle point is an alternative to reduce *indecisiveness*. The level of agreement with the item in question also represents the level of awareness about the measured topic.

The questionnaire was composed of 90 items in the two main areas: Personal Attributes, 42 items from 7 elements; and Design Skills, 48 items from 4 elements. Most items within Design Skills referred to the job itself rather than to an individual's reaction to the job, reflecting the respondents' perception of their behavior and performance in the workplace. Individual reactions and perceived personal characteristics were treated by the personal elements. To achieve adequate internal consistency and reliability yet maintain reasonable survey length (Morgeson and Humphrey, 2006), six items was used to assess each element, as shown in Table 2. The items were randomly distributed and automatically randomized within the group for each participant.

All the scales were refined and submitted to pilot testing and underwent two waves of formal pre-tests among researchers to assure readability, intelligibility and content validity. Comments and suggestions provided from the pre-test were used to revise the questionnaire, such as to remove ambiguities and other sources of confusion.

Table 2. Designers' Professional Identity Elements for measurement

Categories	Elements	Description	Nr.
Personal Attributes	Ethics	*Awareness and positioning about any possible environmental, social, health or design life performative consequences, or lack of compliance to legislation.*	6
	Emotions	*Sensitivity to external inputs, self-awareness, and management of personal feelings, also related with moral and empathetic aspects.*	6
	Social abilities	*Perceived facility on the exchange of tacit knowledge via joint activities: being together, living in the same environment, sharing experiences, and transferring ideas to other people.*	6
	Leadership	*A sense of autonomy and managerial attitude, searching and promoting ideas among strategy and business view together with peers guidance and inspiration.*	6
	Responsibility	*Motivation and willingness to learn, assuming responsibilities from mistakes, conscientiously assuming risks, taking care of project details, deadlines, and working within own beliefs*	6
	Openness	*Acceptance and embracement of new and unusual ideas or methods, being able to make changes to the work plan relying on the ability to improvise and remake. Also refers to the capacity to deal with different topics and to work with people from different cultures, ideologies or beliefs.*	6
	Confidence	*Certitude of its own personal abilities and professional competencies, being able to embrace innovative ideas and to start challenging projects, justifying own beliefs and (ethical) work.*	6
Design Skills	Cognitive Skills	*The capacity of think 'designerly'; understanding the nature of the problem to be solved; developing a distinct way of thinking that set the notions about the problem and solution spaces; demonstrating a high level of abstraction ability during exhaustive idea generation processes, subjective interpretations, and evaluation rounds. This dynamics of understanding, thinking, abstracting and evaluating the design problem leads the designer to set strategies of learning, problem framing, solution development, and problem-solving that allow the flow of these cognitive abilities.*	12
	Communication Skills	*Awareness of it communicative ability in a personal and interpersonal level. It comprehends the capacity to communicate clear and directly, attending to details and empathizing with an audience. Also, to make public presentations, set collaborations, establish rapport, and communicate among a team.*	12
	Technical Skills	*Educational and practical knowledge in design. It undertakes awareness of basic and specialized competencies that compound the formal education in design, and also technical language, imagination/representation quality and speed, IT competencies, negotiation, and knowledge appliance ability that compound competencies based on practice, expertise and know-how.*	12
	Management Skills	*Perceived managerial competence in a personal level and with the colleagues or among the team. Also, competence in developing and managing the project such as planning, progressing among the tasks and phases, and evaluating effectiveness and outcomes.*	12
		Total number of items	**90**

4 RESULTS AND DISCUSSION

Professional self-identity is a framework in which personal and professional elements are taken into account. These elements start to be developed during the professional education process and are expressed as changes in awareness of behavior and knowledge over time, also becoming a pre-requisite for taking up professional responsibilities and values. As such, we first outline results for each population (Bachelors and Masters) before discussing development over time.

4.1 Bachelor Students in Design

The beginning of education in design is at the bachelor level and describes the starting point of the developed knowledge and professional perception in the educational process. The majority of respondents at this level were actually in the middle of their educational process at university, within the 2nd year. Figure 1 represents the sampled students in a radar graph in order to give a profile overview. The results, calculated by the mean of each category, broadly align with the elements derived from literature but the awareness level of the respondents is relatively low. The element Openness, related to Personal Attributes, usually express a way in which the students see themselves as being "open minded" and showed the highest score for this group of respondents. All the other elements rated quite low, especially Technical Skills.

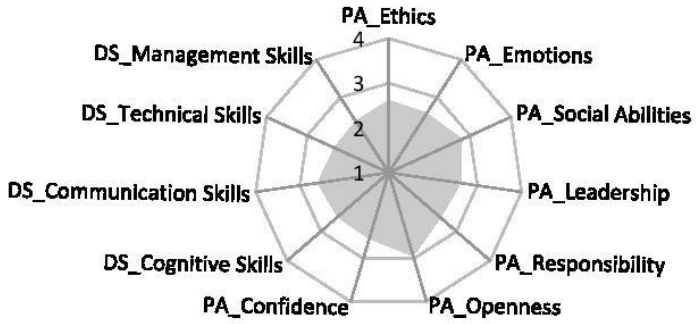

Figure 1. Radar graph of elements from Bachelor students in Design

4.2 Master Students in Design

The Master level might be considered the last stage of formal education, from where a student can choose to become an academic or go to industry. Thus, it is expected that this set of respondents already has all the educationally provided knowledge, having also developed skills of "professional beginners", while still lacking expertise from working in the field. Figure 2 represents the profile of master students. Here, the master students present higher agreement with the elements than the bachelors, and so perceive themselves in a slightly more rounded and robust profile in comparison to Figure 1.

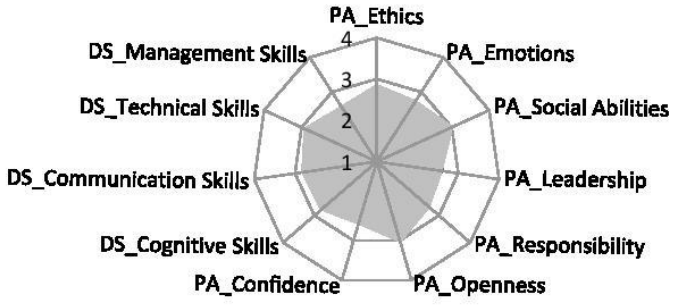

Figure 2. Radar graph of elements from Master students in Design

4.3 Development of the elements over education

In order to give an initial insight into development over time, a coarse comparison of means was undertaken across each element. Further analysis of this development is on-going and is outlined in Section 5, however, these initial results provide key insights into the two main RQ's outlined in Section 1. Thus, by comparing the profiles from bachelor and master students it is already possible to visualize a small change in self-perception and awareness levels across elements over the educational period. Figure 3 illustrates this comparison and the increase in awareness related to mainly Design Skills (DS), that is the focus of education. To which the elements related to Personal Attributes (PA) present the stability that characterizes a slowly changing process associated with this group of elements.

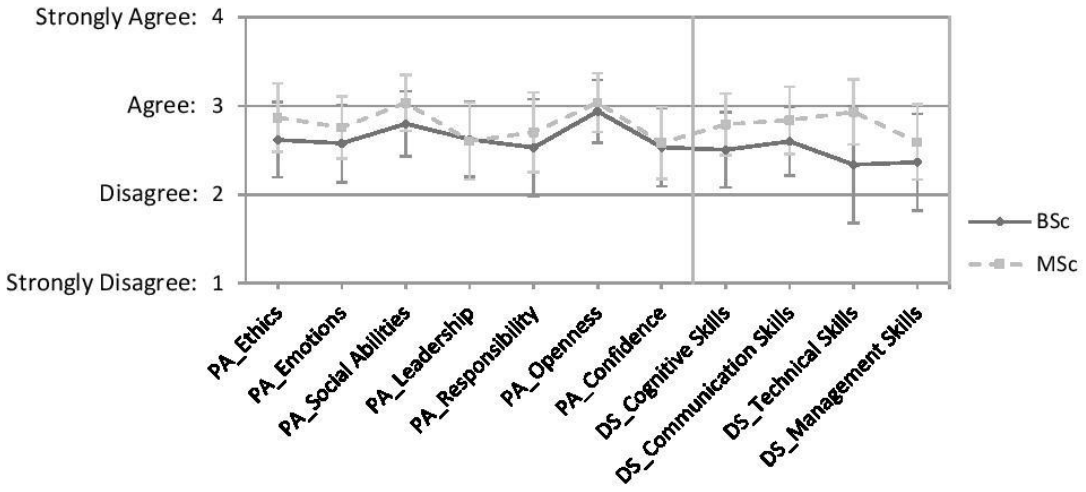

Figure 3. Comparison graph of elements between Bachelors and Master students in Design

The positive changes in the means of the elements related to Design Skills can be associated with the educational and training process over the undergraduate period. The curricula that compose design education in the measured university embraces the development of Cognitive, Communication, Technical and Management skills, which is reflected in an increase of 20% on the average mean for Technical competence and around 10% for the other three elements at the masters level. However, within Personal Attributes, only the first three elements present a difference in the mean average of around 10%, while the other four elements have shown little change (Table 3).

Table 3. Descriptive Statistics of DPI elements for BSc and MSc.

	BSc			**MSc**			*Difference between BSc and MSc*	
	Mean	*SE*	*Var*	*Mean*	*SE*	*Var*	*Diff (%)*	*T-test*
PA_Ethics	2,62	0,42	1,23	2,87	0,39	1,10	0,25 (9%)	0,42
PA_Emotions	2,58	0,44	1,02	2,76	0,35	0,78	0,18 (7%)	0,42
PA_Social Abilities	2,80	0,36	1,02	3,03	0,32	0,89	0,23 (8%)	0,39
PA_Leadership	2,62	0,42	1,03	2,60	0,43	1,17	-0,02 (-1%)	0,40
PA_Responsibility	2,53	0,54	1,37	2,70	0,45	1,37	0,17 (6%)	0,48
PA_Openness	2,94	0,36	1,08	3,04	0,33	0,95	0,10 (3%)	0,48
PA_Confidence	2,53	0,44	1,27	2,58	0,40	1,08	0,05 (2%)	0,43
DS_Cognitive Skills	2,50	0,42	1,06	2,79	0,35	0,91	0,29 (10%)	0,37
DS_Communication Skills	2,60	0,39	0,93	2,84	0,38	1,07	0,24 (8%)	0,36
DS_Technical Skills	2,34	0,66	1,66	2,93	0,36	1,07	0,59 (20%)	0,13
DS_Management Skills	2,36	0,54	1,51	2,59	0,42	1,16	0,23 (9%)	0,30
Total	**2,58**	**0,45**	**1,20**	**2,79**	**0,38**	**1,05**	**0,21 (8%)**	**0,38**

The currently differences in the means were not found to be significant for the individual elements, due to the high variance of the responses among the categories (Student's T-Test: single-tailed distribution, heteroscedastic). However, considering that the two groups, Personal Attributes and Design skills, develop at distinctly different speeds, the difference among the groups becomes more expressive and significant when measured as a whole, also indicating alignment with the framework of DPI development in these two sets. The measurement considering all the elements within Personal Attributes or Design Skills presents considerable differences between bachelors and masters: p=0,082 for PA and p=0,006 for DS.

The high variance within the responses is present for both groups, slightly reduced at the masters' level. This information supports the described "internal confusion", or *Moratorium* period, in which the measured subjects are in while still shaping a professional identity. Thus, it is expected that years of practice and immersion in a professional environment are required to overcome this noise in the data, and so the measurement of DPI elements to become more robust when with more experienced respondents. The measurement of professional subjects is planned as a given sequence to this study.

This first psychometrical assessment allowed us to visualize a clear tendency of higher agreement and awareness development over the designer's educational path. According to the expectations, the Personal Attributes presented a slower development expressed by a small difference between bachelor and master students. However, Design Skills present a significant difference as result of 2-3 years of students learning process at the university. From these results, is possible to estimate the increase of self-awareness development over education in design that is focused mainly on Design Skills.

The positive trend towards agreement, with the pre-set statements in the survey, over education, indicates the evolution of student's self-concept toward an alignment with literature in Design. This alignment trend with the conceptual aspects and requirements establish a bridge between theory, practice and the construction of a professional self in the design field. Thus, the measurement of all elements and how they are expressed indicates the first step towards a better understanding of career development in design.

5 LIMITATIONS AND FURTHER RESEARCH

The study, as a primary exploratory compiling of this survey, has some limitations. First, the results are related only to students enrolled at a specific university. It represents students under developmental process within a technical university in a Scandinavian context that likely differs from design education within design schools or based in other cultural environments. Also, it does not constitute a traditional longitudinal study but rather a picture of these subjects at different educational periods: bachelor and master level. However, the general trends identified to support the usefulness of further analysis and data collection using this approach.

Second, it was the first broader data collection of a newly developed survey instrument that is still under refinement. Also, since the measured categories are based on a previous literature review this study might not have covered all possible elements in reality. However, books that frame design expertise and engineering design were used as secondary literature, and broadly align with the general improvement observed between bachelors and masters in this study.

Third, the in-depth discussion of the elements and its possible relations were limited here. External factors that influence high variance in responses, and might have played a role in increasing the variance within the responses could also be further analyzed through the refinement of demographic and experience variables within the data. Also, gender differences were considered not significant in this study due to a similar percentage of male (52%) and female (47%) respondents. However, it is worth further analyses to explore possible differences in the two groups, in particular if expanding the study to cross-cultural measurements.

Fourth, a wider evaluation would support more general conclusions about validity. The results from the survey were subjected to a commonly used validation process to assess the scale's reliability, validity, and unidimensionality, which was not presented in this paper for space reasons. As such, further reliability analysis and follow-up interview studies will be carried out in order to validate the findings outlined here. Some of the planned analysis are: **Internal Consistency Analysis (ICA)** to verify the if the items are true representative of the proposed category; **Exploratory Factor Analysis**; definition of a **Herfindahl index** to the categories in order to establish a meaningful-weighted measure that allows comparisons; and an **Exploratory correlational research** for all the items and elements. Following the

recommendation of Churchill (1979), items with low item-to-total correlation will be eliminated because they don't share sufficiently in the construct's common core. Hereafter, all scales were subjected to a **Principal Component Analysis (PCA)** and/or **Factor Analysis (FA)** with varimax rotation.
The goal of the next steps of this research is the refinement of the survey that, allied with deeper qualitative data, could allow a better comparison among the clusters, including professional designers with different levels of experience. The results of the broader scope of this research and the data from the professionals in the field can also allow a further development of a tool to diagnose curricular features that influence the development of designers' professional self-identity over education.

6 CONCLUSIONS AND IMPLICATIONS

The process of learning how to become a professional in design, as well as the process of constructing a professional identity, demands both personal and technical growth. The elements that compound these aspects can be understood as Personal Attributes and Design Skills; intrinsically related with each other and, within an economic, social, and professional context, and evolving over time.
The elements that compound the framework of DPI used in this study came from a systematic literature review (Kunrath et al., 2016), and have been described as essential aspects for a designer. The holistic overview cannot be dissociated and measured by just one or another dimension (e.g. only by designers' competencies), rather it must provide a broader humanistic understanding of the designer that includes personal features and situational elements.
In this paper we examined how these elements developed over the course of an education by comparing bachelors and masters students in design with the aim to answer two main research questions: RQ1) Are the students' self-awareness on Personal Attributes and Design Skills aligned with the Design literature? RQ2) How does the professional identity evolve over the course of education?
The measurement from the survey indicates a trend of development in self-awareness level due to the progression in higher education. This positive trend indicates an alignment with the concepts from literature in Design over the development of professional identity. The analysis did not present a statistically significant difference, among the groups of students, for the elements when measured separately but rather when measured as two groups: Personal Attributes and Design Skills.
As separate sets of elements, the data confirms the expectation of different speeds of development between PA and DS. Thus, while Personal Attributes develops very slowly Design Skills are deeper developed and trained during the educational period. As the designers' career progress, it is expected that awareness will increase for professional designers, due to experience and strengthening of professional self-identity after the *Moratorium* period associated with learning a profession (Skorikov and Vondracek, 2011). However, a tendency of increasing awareness can be already perceived as a trend within the educational period.
The results bring implications for theory and practice in design, since they highlight trends in capacities and competencies development and also the relationship between skills and personal attributes. This has specific implications for both design education, as well as the management of skills development in practice. It is observed that a delayed professional self-identity shaping can become a barrier to successful transitions from student to professional level (Crossley and Vivekananda-Schmidt, 2009). The study also contributes a milestone in studies of professionalism in design, shaping the profile of bachelors and master students, comparing them through the evolution in self-awareness in a professional-related psychometric test, and setting the stage for further studies that provide an understanding of professionals in design, and the development of the student to an experienced designer.

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3. Designer's Identity: Skills' self-perception and expectation in design students

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DESIGNERS' IDENTITY: SKILLS' SELF-PERCEPTION AND EXPECTATION IN DESIGN STUDENTS

K. Kunrath, P. Cash and J. Li-Ying

Abstract

Designers' Professional Identity (DPI) combines social- and self-perceptive awareness through which one is able to identify as a designer. However, self-perception can be different from the expectations associated with an ideal designer, especially during education. Thus, this paper reports a survey where self-perceived design skills and expectation are compared at different points in a design education. Findings indicate that changes in mindset modify the alignment between self-perception and expectations, which provides implications for education and for a broader understanding of DPI.

Keywords: professional identity, competence expectation, design education, design learning, human behaviour

1. Introduction

The process through which a designer comes to develop a distinct professional identity plays an important role in professional development. This is particularly significant for design students, as it is key to building self-confidence and self-realization as a qualified professional. This sense of belonging to a profession can be seen as a social- and self-perceptive awareness of professional values and skills, integral to the professional mindset. Ultimately alignment between self-perception and expectations of the profession is key to self-realization and work performance in a specific role.

The professional consciousness is a core element of personal identity and thus plays an important role in one's confidence and professional development (Skorikov and Vondracek, 2011). However, inconsistencies between self-perception and expectation can disrupt confidence building and sense of belongingness in the professional context, negatively impacting the process of professional identity formation. The main components associated with the formation of a Designers' Professional Identity (DPI) are the level of awareness of personal skills and their alignment with internal and external expectations (Haslam and Ellemers, 2011; Kunrath et al., 2016).

The external expectations that contribute to this professional understanding are the basis for stereotyping the designer. Here, key characteristics have been widely discussed as designerly ways of thinking and as trained competences and abilities (Cross, 1982; Adams et al., 2011). However, in each specific context the expected characteristics of a 'good designer' may vary e.g. educational, society understanding, or work environment. During education, the goal of skills acquisition is directed by academic rubrics and evolves towards an expected set of characteristics previously established by the university's curriculum and approach to design. However, the way in which students – at different levels of education – perceive themselves in this context is less specifically managed. As such, discrepancies between the stereotype of an 'ideal designer' and the students' self-perceptions can impact the development of Designers' Professional Identity (DPI). Similarly, understanding of professional role and the feeling of belonging to a professional group can be undermined by divergence between self-

perception and external expectation. As such, there is a key research need to understand how the interaction between these elements (required skills and expectation) changes over time in the context of design education.
To address this need this paper seeks to take the first steps in answering the RQs: 1) How does students' expectation, of the ideal skills composition for a designer, evolve over the course of education? 2) What are the differences between the students' self-perception and expectations? To answer these RQ's this paper presents data from a psychometric survey combined with a skills rating exercise, carried out with first year Bachelors and final year Masters Design students. Results are discussed based on the first descriptive statistical analysis and implications are derived for design theory and practice.

2. Literature review

The study of professional identity has deep roots in psychology, where the aspects of self and identity have been widely discussed as the point around which personal development and occupational identity interact (e.g. Schwartz et al., 2011). The way in which somebody perceives themselves as a professional is a reflection of self-awareness and is usually based on an expectation of an ideal model, seen as a goal to be achieved. This inspirational stereotype guides the development of a self-understanding and the sense of being part of a professional group (Haslam and Ellemers, 2011). The process of professional identification formally starts during professional education and, by running life-long, impacts the development of confidence as a professional as well as overall performance at work (Dannels, 2000; Schwartz et al., 2011).
In this setting the Designers' Professional Identity is a topic that embraces not only psychological issues during education but also elements of management and human resources in the job market. Here, professional identity determines professional satisfaction and improvements in competence and performance within the work environment (Ashcraft, 2013). Particularly for designers, the consolidation of a professional identity contributes to a smoother transition from student to professional status by promoting a professional development path based on awareness of what it means to be a designer in practice. Hence, professional understanding enables students to better adapt to the challenges in a field (Evetts, 2003; Tracey and Hutchinson, 2013).
Theoretical models from adult education research suggest that expectation-value approaches (i.e. Wigfield and Eccles, 2000; that postulate a positive relation between intrinsic motivation and competence beliefs) can promote further learning, motivation, and self-efficacy; and together with emotions associated with prior experience, are considered to be central to adult learning (Freiberger et al., 2012; Gorges and Kandler, 2012). Thus, understanding and aligning students expectation and professional understanding is an important part of professional development, and describes a gap between students' expectations in competencies, based on university requirements, and the characteristics actually demanded from real-world employers (Wells et al., 2009).
To address this need educators often use simulations and projects to build awareness of real world challenges. As suggested by Luehmann (2007), *"this approach to learning gives participants opportunities to experience success in meaningful ways and in scaffolded situations, and thus encourages ongoing engagement"* (p.289). However, there are challenges in incorporating additional experiences from practice in the education (Luehmann, 2007), and also in promoting identity development in ways that are rich in self-reflective processes and point to an achievable professional expectation model. The alignment between expectation and self-perception is illustrated in Figure 1, which forms the research framework for this work. Here, self-perception moves towards alignment with professional expectation, as knowledge and expertise are acquired over an education. In design practice, this would imply that the shared professional beliefs (such as ethics and social impact approaches), role understanding and assumptions - intrinsic to the professional title - would predetermine actions and practices expected from professionals (d'Anjou, 2011).

3. Methodology

The present study employed a self-administered online questionnaire, using the Qualtrics platform. This was used to deliver a psychometric test in which respondents report their own tacit perceptions; as has been widely used for assessments of professional identity in the literature (Crossley and Vivekananda-

Schmidt, 2009; Cowin et al., 2013). The quantitative part of the data is examined at Kunrath et al. (2017). In this sense, this study examines specifically the students' self-perception of design skills in comparison to expectations of an 'ideal designer'.

The design skills considered in this study were drawn from the recent systematic literature review by Kunrath et al. (2016). Here, Kunrath et al. describe the cognitive, technical, and behavioral skills related to the practice of design activity. This study made use of those characteristics claimed to be possible to explicitly train within the educational and practical contexts (Horváth, 2006). The survey collected information from students at two points in a design education at a technical university: bachelor (N=104) and master (N=79). Participating students where accessed during the second semester of 2016. The survey presented a response rate of 83% for bachelors and 63% for masters.

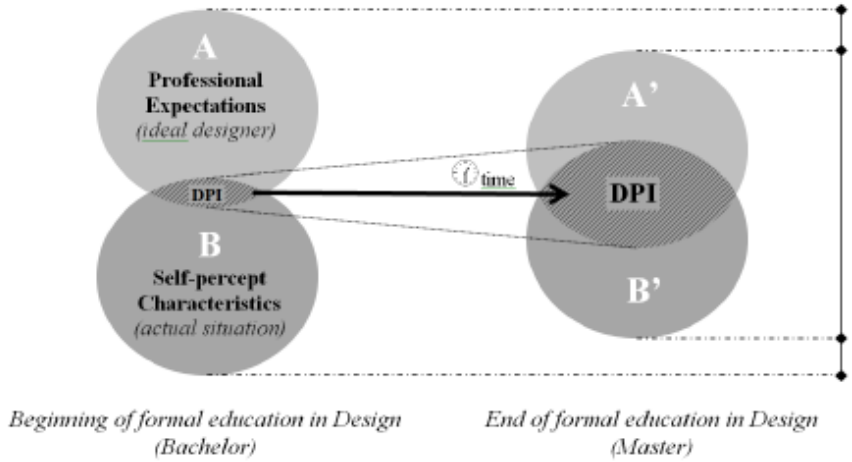

Figure 1. Framework of DPI development through the alignment between self-perception and expectation

3.1. Survey design

The survey was designed to allow each respondent to say how much they identify with pre-set self-statements related to elements of design skills, in order to elicit personal constructs about skills and career development. Each element was assessed via Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree) with a neutral option "I don't know" in the far right position of the scale. Each element comprised 6 individual items in order to increase robustness and reliability. The level of agreement with the item in question represents the level of awareness about the measured topic and alignment with the construct. The design skill elements primarily referred to the job itself, reflecting perception about behavior and performance in the workplace (see full list in Table 1).

As part of survey development, particular attention was paid to question wording so as to match prior design literature. Thus, survey design was followed four main principles: (1) reflect the construct definition derived from the design literature; (2) be distinct from the other identified characteristics; (3) not exceed a maximum length of 20 words; (4) not have an explicit measurement meaning. Table 2 illustrates, as an example, the items used for one of the measured elements. In addition to the self-perception questions participants were also asked to rank, in order of importance, the elements of design skills. The result of this ranking exercise was interpreted as expectation.

The questionnaire was comprised of a balance of positive and negative sentences (referring to the opposite relation/meaning of the intent measurement). Six items were used to assess each element to achieve adequate internal consistency and reliability yet maintain a reasonable survey length (Morgeson and Humphrey, 2006). The items were automatically randomized for each participant. Further, all the scales were refined via two waves of formal pre-tests in order to clarify the items and check readability, intelligibility, and content validity. Changes in perception across the education were analyzed relating to the two groups.

Table 1. Designers' Professional Identity elements for design skills

Categories	Elements	Description	Nr.
Cognitive Skills	Cognitive Abilities	*Capacity of think 'designerly'; understanding the nature of the problem to be solved; developing a distinct way of thinking about the problem and solution spaces; demonstrating high level of abstraction for idea generation and evaluation rounds.*	6
	Cognitive Strategies	*Ability to set strategies of learning, problem framing, solution development, and problem solving that allow the flow of the cognitive abilities.*	6
Communication Skills	Personal Communication	*Capacity to communicate clear and directly, attending to details and empathising with audience.*	6
	Interpersonal Communication	*Awareness of communication ability in order to make public presentations, set collaborations, establishing rapport, and communicate among a team.*	6
Technical Skills	Education-based Knowledge	*Awareness of basic and specialized knowledge in design that compounds the formal education, and domain of technical and design language.*	6
	Practice-based Knowledge	*Abilities based and developed through practice, expertise and know-how gain. Such as good imagination/representation, IT competencies and use of software, negotiation capacity, and appliance of previous knowledge.*	6
Management Skills	Manager Capacities	*Perceived competence for managing generic tasks, in a personal level and with the colleagues or among the team.*	6
	Project Management	*Competence in developing and managing the project such as planning, progressing among the tasks and phases, and evaluating effectiveness and outcomes.*	6
		Total number of Design Skills items in the survey	**48**

Table 2. Example of element's items developed and used on the survey

Element	Items (self-reflective sentences)	Relation
Cognitive Abilities	*I find it easy to consider different perspectives on problems*	+
	It is easy to visualize the final product before start the design process	+
	I find it easy to simplify complex problems	+
	It is hard to create a new concept by associating different ideas	-
	It is not easy to find the key elements in a problem/solution/design.	-
	It is difficult to judge the intentions behind a design	-

4. Results and discussion

4.1. Self-perception of bachelor and master students in design

By comparing the results of the psychometric survey, as an aggregate of the four the main categories of design skills (Table 1), there is a significant trend of an increased agreement (Figure 2). The association of the reported behavior and values with the elements from literature can be consider as a reflection of the student characteristics, and indicates an increased level of awareness in each measured element. By this way, the results indicate an increase on the awareness over the period of formal education in Design, aligning with expectations from literature (Ahmed, 2007; Abdullah, 2014) and supporting the overall validity of the results from this work, providing a platform for further analysis.

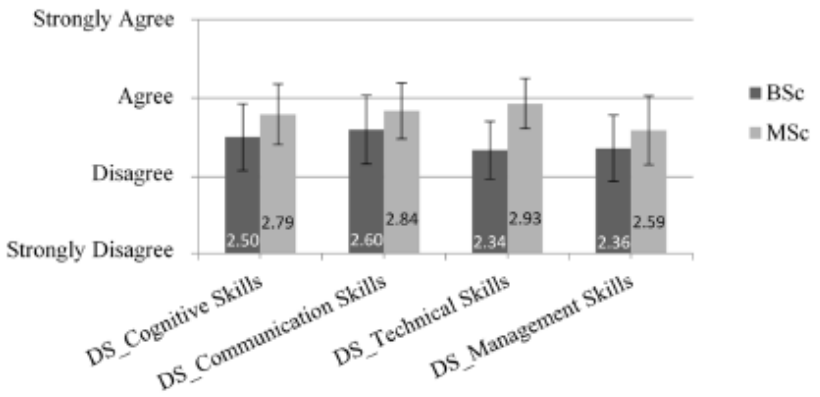

Figure 2. Graph of design skills elements from students in design

4.2. Expectations about design skills

When asked to rank the importance for the elements of design skills in order to describe the expected profile of an *ideal* designer, the surveyed students again showed substantial differences. This change in expectation was shown to be aligned with their own changing understanding of professional role associated with their on-going education. Table 3 presents the mean results of the ranked elements in order of importance based on both psychometric survey and expectation exercise.

Based on Figure 2 awareness increased across the educational. Similarly, this development of awareness reflects a change of importance attribution from Bachelor to Master students in Design (Table 3). Thus, not only does self-perception change but also the expectation of an *ideal* professional in Design, which challenge the development towards a socially accepted stereotype.

Table 3. Self-perception and expectation ranks of design skills for BSc and MSc (most important = 1)

		Self-Perception Rank (Scores)		Expectation Rank (the ideal designer)	
		BSc	MSc	BSc	MSc
DS_Cognitive Skills	Cognitive Abilities	2	2	2	1
	Cognitive Strategies	3	6	4	2
DS_Communication Skills	Interpersonal Communication	5	1	1	3
	Personal Communication	1	8	8	6
DS_Technical Skills	Education-based Knowledge	8	4	6	4
	Practice-based Knowledge	5	5	5	7
DS_Management Skills	Manager Competencies	4	7	7	8
	Project Management	6	3	3	5

Figure 3 elucidates the change of importance attribution from BSc to MSc students, and so the expectation for the elements of design skills. Here, some of the elements with higher value at the bachelor level, such as *Interpersonal Communication*, *Practice-based Knowledge*, and *Managerial Competencies*, face devaluation in order of importance at the master level. However, competencies related to the cognitive aspects of design, *Personal Communication*, and *Knowledge from Education* become more important. These differences in ideal composition indicate the development in role and values understanding; as well as a more practical and realistic approach less supported by assumption. Studies shown that simulated experiences can create a sense of real-world engagement and professional practice (Luehmann, 2007; Zou and Chan, 2016) if the context is set in a way to properly simulates a work environment when perceived by the students (Dannels, 2000), enabling earlier professional values

to be introduced in the educational process for a more realistic the projection to what the beginners can become; fostering the process of Professional Identity formation through a clarified path of development.

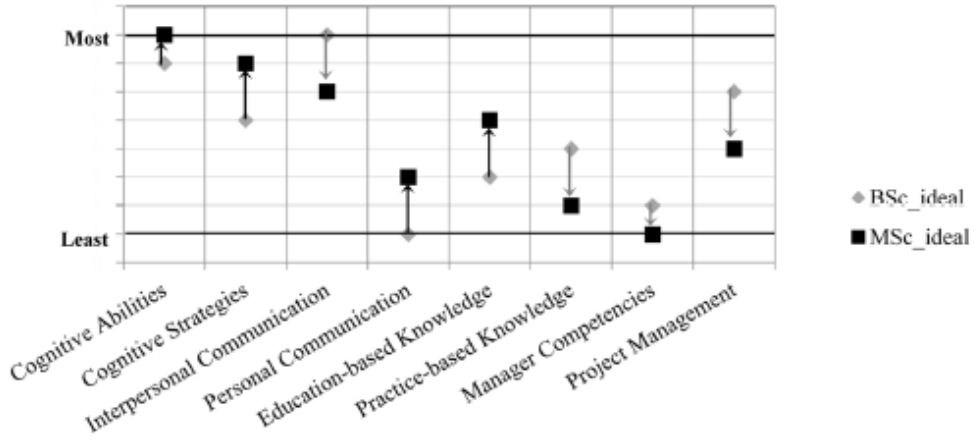

Figure 3. Differences in expectations trough the rank of design skills

4.3. Designers' Professional Identity (DPI) development

As highlighted in the above results evolution of self-perception and expectation reflect a shift towards the most valued characteristics identified in the design literature (Oxman, 1999; Lewis and Bonollo, 2002; Robinson et al., 2005). Figure 4 illustrates this comparison between self-perception and expectation for both bachelor and master students. The pattern on radial graphs expresses the difference in value attribution for each element of design skills. As such, the pattern visualizes the discrepancy between the results of the psychometric self-perception survey and the conceptualization of ideal composition of skills (expectation).

Bachelor students scored very low in perception of cognitive abilities, meaning that they don't recognize themselves items related to this quality. However, they attribute this element a high expected importance, just after *Personal Communication*. Master students, however, scored very high perception and expectation in this category, reflecting the process of awareness development. This illustrates how with knowledge and experience acquisition, students not only start to identify *Cognitive Abilities* as a key skills element but also start to identify themselves with the activities related to thinking, understanding, and evaluating the design problem, and so to attribute higher importance to the characteristic of 'designerly' thinking (Cross, 1999, 2001).

Similarly, *Interpersonal Communication* was identified, by the bachelors, as the most important skill for a designer; even though they did not identify this element in their own self-perception. The literature emphasizes the importance of external recognition for the development of professional identity since it is also socially constructed via interactions with others, particularly those within the community of practice (Dobrow and Higgins, 2005; Tracey and Hutchinson, 2013). Thus, it is possible to assume that to achieve this expectation, students invest time and effort in developing this element during their education; reflected in the high awareness and self-perception by the master students. Finally, *Personal Communication* is the element that most dramatically represents the change in students' mindset from bachelor to master. At bachelor level this is the skill that students identify the most, despite assigning it little expected importance. However, as knowledge from education is acquired, the importance attribution and alignment of expectation and self-perception increases at the master level. According to Tracey and Hutchinson (2013), helping novice designers to build the preliminary foundation of their professional identity is a key component of graduate training by attempting to overcome the lack of *"experience, knowledge of their beliefs about design, and self-awareness of their emerging identity as*

designers" (p. 29). As such, formal training through education actively reshapes the value attribution for this and other elements of design skills (Dannels, 2000).

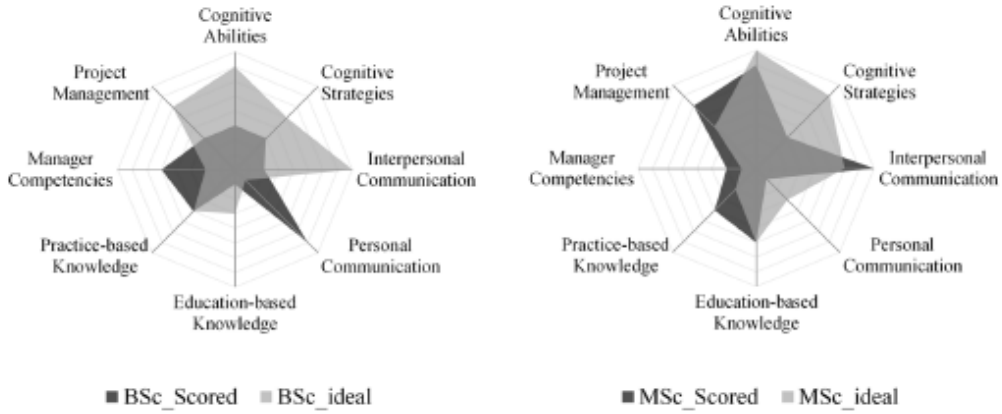

Figure 4. Comparison of differences in self-perception (score means) and expectation (ranking means) on design skills for BSc and MSc

These rearrangements of expectation and self-perception are in accordance with the research framework presented in Figure 1, and also the results illustrated in Figure 4. The differences in professional expectation and the understanding of the self also indicate the level of awareness in relation to the students' own competencies and their role as future designers. The misalignment between expectation and self-perception of Practice-based Knowledge at master lever reinforces this increase in awareness and role understanding by assuming a higher self-perception.

Research in several fields supports the idea of professional identity as a critical and formative process that occurs during an educational program and continues throughout a lifetime of practice (Skorikov and Vondracek, 2011). Although, social, demographic, and personality factors are also known to contribute and impact identity (Dobrow and Higgins, 2005; Crossley and Vivekananda-Schmidt, 2009), this study illustrates the core role of the Designers Professional Identity and its development as a complementary perspective to traditional skills focused training in design education (Mann et al., 2009; Kunrath et al., 2017). The results illustrate the changing connection between self-perceived skills and expected designerly ideal over the course of an education. The acquisition of knowledge and training during education unfold a progression in awareness, explained by the increase in self-recognition within the elements from literature, and the raise of professional belongingness and role understandings, expressed on the move towards an alignment with expectations. Thus, this extends prior conceptualizations of a relatively linear development towards the professional designer (i.e. Yang et al., 2005; Carmel-Gilfilen and Portillo, 2010). In particular, the findings reported here suggest the need for an increased focus on expectation shaping early in design education in order to mitigate the substantial disconnects between bachelor and masters expectations. This adds to prior studies that address the process to become a professional designer (Dannels, 2000; Dall'Alba, 2009; Wells et al., 2009; Adams et al., 2011), and extends theory by approaching self-perception and expectations as elements that reflect awareness and contribute to this path.

5. Implications and limitations

Key implications of this research are the need to better understand the scope of self-perception and identity development in designers over time – including during professional development. Further, this work highlights the importance of addressing both practical skills and expectation early in design education in order to better align professional development and self-realization.

Further work should address the inclusion of design professionals in order to provide a deep understanding of the reflections of self-perception and expectation development towards DPI. An in-

depth qualitative study could also enrich this area by pointing out nuances and interpretations, revealing the understanding of the participants about design roles and values in a contextualized approach. However, this work contributes to understanding of how designers develop during the educational process in a technical university and points to the need for further work specifically in resolving what constitutes designers professional identity, and how this develops over time in a deeper and broader sense.

6. Conclusions

This work set out to start to answer the RQs: 1) How does students' expectation, of the ideal skills composition for a designer, evolve over the course of education? 2) What are the differences between the students' self-perception and expectation? By understanding this interaction between self-perception and professional expectation is an important aspect in professional development and professional identity. Further, it also allows the designer to set goals in order to focus training and efforts towards a projection of a 'strongly qualified' professional.

Based on the reported results is possible to conclude that, more than the expected alignment suggested by prior literature, students were able to direct their training towards their expectations. Thus, setting the projection of the *ideal* professional as a goal to be achieved, students unfold both self-awareness and professional expectation. However, this reflective process was not a linear development, with a number of skills rising and falling in importance with respect to both self-perception and expectation; bringing new challenges based on the strengthening, reinforcement, and usage of a designerly mindset. Thus, this research highlights the need for an earlier and better understanding of the composition of and alignment between professional identity development and education/career path. In particular, this has significant implications for design education, professional development, and theory regarding design mindset and identity.

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