UNIVERSITY OF TWENTE.

IDENTITY STATUS: THE CONTENT AND DEVELOPMENT OF THE PROFESSIONAL IDENTITY OF STEM-STUDENTS

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Master Thesis Educational Science and Technology

30-3-2016

Title of the final project
The professional identity of STEM-students

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Keywords
STEM-students, professional identity, identity status, self-to-prototype matching, career choice

Acknowledgement

Performing a master thesis was a unique experience for me. Formerly I could not imagine I would do this and now I am very proud of what I achieved. It was a very informative process with the accompanying ups and downs. I would like to thank a couple of people who supported me during this project.

First I would like to thank my supervisors. Both Ruth and Maaike have heaps of knowledge and are very professional. In the beginning, I was looking up to them but along the way they inspired me. I am grateful for the honest feedback and compliments regarding my development. This encouraged me to work even harder. My friends helped me with finding participants, broken computers and fun distraction from my master thesis. Thank you for your ‘listening ears’ and the patience you had when my head was full of graduation. Lastly, I could not do this without my parents and sister. My graduation process was accompanied by special period for us all. Despite the difficulties I encountered, you were able to comfort me. Thank you very much for your support and the confidence you had in me. Even though I did not always agreed, it was good you put on the brakes sometimes. You taught me to be thankful and proud for what I am doing.

With my graduation I will finish my study Educational Science and Technology. However, learning is not over and based on this master thesis I will start with fresh courage with my second master thesis for Psychology. I discovered the professional identity of STEM-students, and now I will work on my own professional identity further.

Mag het licht uit?

~ De Dijk

Contents

Abstract

Although more and more students choose for a technical study, not all these students choose for a technical career. Reasons for this are still unknown. As identification with the profession can be seen as one of the main determiners of a successful career, the proposed research focused on the content of the professional identity of technical students (i.e. STEM students) and measured the extent to which STEM students' personal identity match with the perceived future as an engineer (professional identity). In addition, the identity status, current career choice and the activities to discover the professional field were examined in both qualitative and quantitative way.

Structured by five categories, 60 STEM-students from the University of Applied Sciences and the University described their personal identity and the professional identity of engineer. A self-to-prototype matching strategy was used to measure the overlap score between the two described identities. No great overlap was found and in addition, there was only a small marginal significant relation with the level of identification. Remarkably, this relation was negative, what insinuates that students who see more similarities between themselves and their future profession did not identify with it. Besides, the identity status was determined to indicate where the participants were in their professional identity development. Five identity statuses were identified whereby searching moratorium was most popular. A significant relationship was found between the level of identification and the specific identity status a STEM-student has. This does not apply to the relation of the level of identification and the career choice (e.g. function and organization). Lastly, a significant relationship was found between the student level and the career choice. The present study tried to provide insight in the content of the professional identity and what constitutes the career choices of STEM-students.

Problem Statement

Technical companies have a significant role in the Dutch economy. Even though the proportion of technical sectors in the employment slowly decreases relative to the total employment, they are still responsible for 40% of the national production and about 66% of the exports. In addition, nearly 80% of the national expenditures is spend on research and development is this sector (Volkerink, Berkhout, Bisschop, & Heyma, 2013). To keep up with the rapid technological developments in the knowledge-driven economy and to update technical knowledge, new technical talent is needed (Ministerie van Economische Zaken and Platform Bèta Techniek, 2015). In the Netherlands there are plenty of employment opportunities for technical employees, and still more to come: Till 2020 approximately 70.000 technical employees will retire, which means that, yearly about 30.000 new technical employees are needed in the Netherlands (Rijksoverheid, 2013). In order to meet the rising demand for technical employees to the Dutch labour market, the Dutch government has several initiatives to increase the number of children choosing a technical profile in schools, to increase the number of technical students, and to retain the technical employees in the technical sector. Such initiatives to stimulate a choice for a technical study is paying off; more and more students choose for a technical study. Whereas in 2009 39% of the students of senior general secondary education and preparatory University education chose a technical direction, in 2013 this was 48% (Ministerie van Economische Zaken and Platform Bèta Techniek, 2015).

Despite the fact that technical studies are promoted and an increased number of students choosing a technical education, a shortage in highly educated technical employees on the job is still indicated (Rijksoverheid, 2013). According to Volkerink et al. (2013), 38% of the students graduating in the field of science, technology, engineering and mathematics (STEM-students) do not choose for a technical profession. In other words, the number of vacancies in the technical industries is higher relative to the number of students choosing a technical occupation. In particular, Volkerink, Berkhoud and De Graaf (2010) showed that the outflow of higher educated technical students in the technical sector is even higher than the outflow of lower educated technical students. Thus far it is unclear why so many STEM-students leave the field of STEM after they graduate, and opt for a career outside the technical sector.

Prior research has shown that the perception people have about a specific profession, can influence their interest. To illustrate this, Schreiner and Sjoberg (2007) argued that representation, status and image of professions are the most influential factors on the choice of education and profession. If this representation is congruent with the characteristics of people's current self-perceptions, it is more likely that someone will be committed to the specific future profession (Hannover & Kessels, 2004; Stryker & Burke, 2000). In other words, the more a student perceives him- or herself to be a "typical technician" the more likely he or she is to find a job in the technical sector. Moreover, professional identification - or the connectedness of the self with a certain profession, is one of the main determinants of a successful career (Pratt, Rockmann, & Kaufmann, 2006). A professional identity can be described as the identification with the set of personal motives, interests, experiences and competences that relate to a profession (Pratt et al., 2006). The extent to which people internalise these characteristics determines the degree of identification with the profession (Stryker & Burke, 2000). Taken together, insight in how STEM students identify themselves with their future profession as engineer or technician and what constitutes such identity may shed light on reasons for the current "gap"; or the number of STEM students opting for a career outside the technical industry.

The purpose of the current research is to understand what constitutes the professional identity of engineers according to STEM-students and how this affects their future (career) choices. As high identification with a profession stimulates commitment and satisfaction about career choices and work, insight in what constitutes the professional identity of STEM-students, how it develops and how it contributes to making career choices in- or outside the technical sector is pivotal. This leads to the following research goals. The first purpose of the study is to describe the content of STEM-students' personal identity and future professional identity as engineer. The second purpose is to investigate the activities students undertake to discover their professional field. Subsequently, the extent to which STEM-students' personal identity match with the professional identity of their future profession "engineer", via self-to-prototype matching (Hannover & Kessels, 2004) will be measured. In addition, the relationship between the overlap of personal identity and professional identity and identification with the future profession will be investigated and subsequently how this relates to the identity status and career choice. Lastly, the current research aims to investigate the relation between the identity status and career choice.

Theoretical framework

Professional Identity

A professional identity consists of personal motives, interests, experiences, and competences that are associated with a professional role (Cech, 2015; Schenk, 1978). According to Van Maanen and Schein (1979, as cited in Ibarra, 1999) professional identity is not only about acquiring new skills, but it also contains adopting associated norms and values of the profession (Pratt et al., 2006). Kroger (2007) adds to this that identity guides the life path of individuals and influences decisions and behaviours. These behaviours, skills, norms and habits are highly different across different professional cultures. For example, whereas communication skills are often valuable for psychologists (Cech, 2014), being practical and good at problem-solving are more typical for the professional identity of engineers (Faulkner, 2000). Professional identity has been studied across different disciplines and has a broad theoretical basis. In the following sections, different theories and models which underlie professional identity will be discussed.

The Comprehensiveness of Professional Identity

Identity is a popular concept among researchers in social sciences. The relevance of studying identity is that this concept explains to a large extent the motives behind people's thinking and doing (Ashforth, Harrison, & Corley, 2008). In other words, identity "helps capture the essence of who people are and, thus, why they do what they do" (Ashforth et al., 2008, p. 334).

Different perspectives on how (professional) identity could be studied exist, depending on the type of discipline in social sciences (i.e., educational, organizational, or social psychological). Most theories and approaches are based on one of two widely known approaches: the ego identity theory from Erikson (1950) and the social identity theory from Tajfel and Turner (1979). These two theories will be discussed below.

Ego identity theory. The origins of the ego identity theory lie in the concept ego identity of Erikson, a developmental psychologist. According to Erikson, an individual crosses several phases during the development of his or her identity (Kroger & Marcia, 2011). Passing these several stages determines the personality of an individual and the attitude someone has towards oneself and the world (Munley, 1977). This developmental process that Erikson (1964) described was originally focussed on the development of the child. Later on, the theory was also used to describe the identity in the context of career development of adolescents and adults (Munley, 1977). In career development, the personality develops over time, and is not static. Through the reciprocal relationship between the self and the society, the individual adapts his or her personality (Stryker & Burke, 2000).

The ego identity theory helps to define the concept of professional identity in the current study. Central elements of identity formation according to the ego identity theory are commitment and exploration (Kroger & Marcia, 2011). Commitment between the profession and the personal identity could be created by reflection, make use of trial and error, examination of past patterns, and in the end integration to formulate a new, professional, identity (Kroger & Marcia, 2011). To illustrate this, during the final phase of his master a student mechanical engineering evaluates his years of studying, considers his preferences, and is doing an internship. After graduation, the process of exploration continues with searching for suitable and interesting vacancies. By the extensive exploration, the student learns his preferences and could find a job that meets his preferences. In this way, commitment is formed with the new professional identity.

Social identity theory. In 1979, Tajfel and Turner developed the social identity theory (Hogg, Terry, & White, 1995). The social identity theory explains that individuals structure their self-perception by means of the social categories they belong to (Hogg et al., 1995). A social category can be defined as two or more individuals who share a common social identity. These social categories serve as aspects of the self-concept and the related social-cognitive processes form group behaviour (Turner, 1982). In other words, social identification is about locating an individual within a system of social categorizations to define answer the question "Who am I". The sum of the integrated group memberships into the self-concept forms the answer to this question (i.e., I am an applied mathematics student, a daughter, a member of my volleyball team, I am Dutch), but also describes the way the individual feels or behaves.

Comparison of ego identity theory and social identity theory. The description of both theoretical approaches to understand identity emphasizes the complexity of the concept. Some differences between the two theories are important to *Note.* First, the ego identity theory puts emphasis on the personal identity of the individual, whereas the social identity theory emphasizes group membership. The importance of the personal identity according to the ego identity theory continues in the fact that the personal identity is about integrating the varied aspects of the environment. In fact, there is a reciprocal relationship between the individual and the society. This makes the identity development a dynamic process, in which the identity constantly adapts. This is in contrast to the social identity theory, whereby the identity is only adopted by a social category. In other words, the individual does not develop an identity by his- or herself, but takes an identity and adopts typical characteristics and behaviours that correspond to the group. For example, an STEM-student adopts the identity of an engineer and defines his- or herself only as an engineer instead in terms of several roles.

Although there are differences between the two theories, both theories have complementing elements that, together, may form a strong theoretical basis to understand the development of professional identities in the context of work and school. Specifically, both theories emphasize a relationship between the society and the self. In other words, the self is constructed by all the identities an individual has (Hogg et al., 1995; Munley, 1977). Moreover, both theories led to behaviour that is in accordance with the specific identity. Using the ego identity theory, the behaviours stem from the specific role, whereas the social identity theory results in behaviour that is in accordance with the group stereotype. A final similarity is the fact both theories encourage commitment with the specific identity. This last remark is a great value for current research as several studies showed that a high commitment with the future profession is a strong determinant for a successful career (Hannover & Kessels; Pratt et al., 2006; Stryker & Burke, 2000).

In recent research, developmental and social psychological perspectives on identity formation are integrated (Amiot, De la Sablonnière, Terry, and Smith, 2007). Amiot et al. (2007) developed a four-stage model of social identity development and integration and combined the principles of the ego identity theory and social identity theory to understand how a multitude of identities can be structured in the self-concept. Current research adheres to this model and also combines both theories. Specifically, this research will focus on investigating the overlap between the personal identity and the professional identity of engineering students. In other words, will the individual adopt the typical characteristics and traits of the professional identity that can be seen as a social group? Based on this theory, the self-to-prototype matching theory of Hannover and Kessels (2004) will be used. The developmental perspective is reflected in the identity status paradigm, which is about exploration and commitment. Both concepts will be discussed later in this theoretical framework.

Elements of Identity

Apart from the theoretical perspectives on identity that are described above, identity is composed of several elements. The discipline from which identity is investigated determines the specific formulation. For example, Van Dick, Wagner, Stellmacher, and Christ (2004) investigated the strength of identification with a profession-related group related to a certain variable. In this way, (professional) identity has been investigated as continuous variable. Another possibility is to investigate the content of professional identity in a more qualitative way. Pratt et al. (2006) studied the professional identity of medicine students by having interviews and analysing secondary sources like archival documents and observations. Current research uses a mixed method to investigate professional identity, based on the definition of Ashforth et al. (2008). In a comprehensive overview article the concept identity is defined in terms of three formulations: *core of identity, content of identity*, and *behaviours of identity*. Each formulation has its own sub elements. The first is the most common conception of identity, namely the core of identity which embodies the strength of identification with a certain group or profession in terms of self-definition (I am a typical engineer), importance (Being an engineer is an important part of who I am) and affect (Being an engineer gives me a good feeling). Second, the content of identity is about the values, goals, beliefs, stereotypic traits, knowledge, skills, and abilities associated with a certain identity (i.e., Engineers value autonomy, typically dress nerdy, are highly analytic, pragmatic and introverted). The third formulation, behaviours of identity, covers all the actions that are typical for the specific identity (I do mechanical engineering). The three formulations of identity are displayed in Figure 1. The variables of the current study will be discussed in relation to the three formulations of Ashforth et al. (2008).

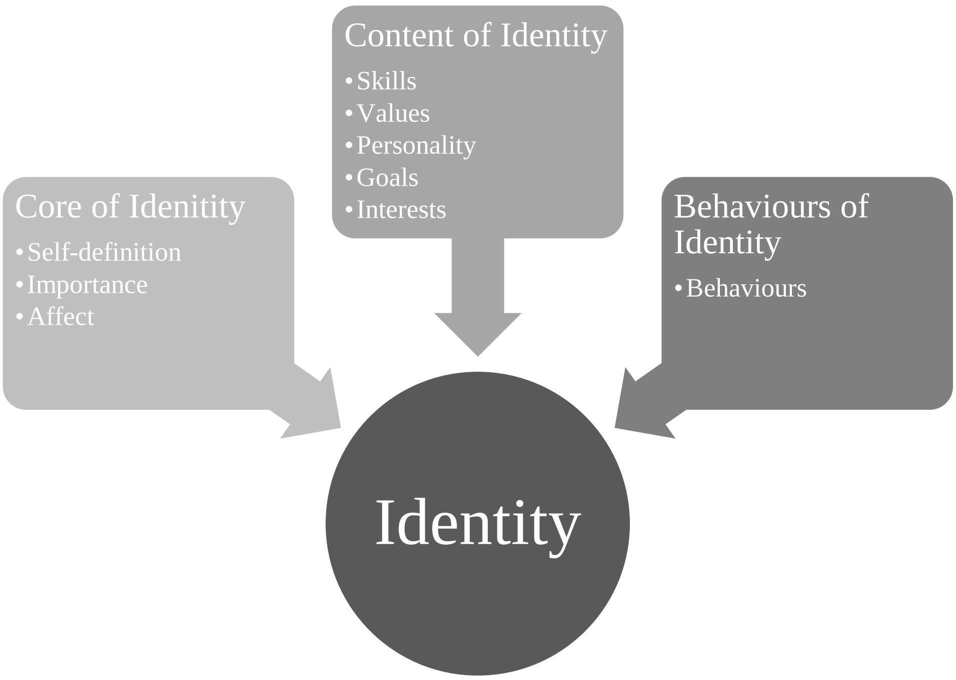

Figure 1. Formation of identity based on Ashforth et al. (2008)

Content of the identity. Every individual has a self-concept; the general view about one's self (Mayer, 2008). Moreover, it is an answer on the question 'Who am I', whereby the personal goals, values, attitudes and memberships define the answer (Markus & Kunda, 1986). During the study, the individual will adapt his or her identity: new, relevant aspects will be linked to the self-concept. For example, for receiving good grades for mathematics, an individual can add to his or her self-concept that he or she is good at mathematics, or that he or she has analytic skills. A crucial factor in forming the professional identity is the consistency between the traits of a profession and the self-concept of a student (Hannover & Kessels, 2004; Ibarra, 1999). The more traits correspondent with the self-concept of a student, the more likely it is that a student will adopt the professional identity. If there are inadequate similarities, students or employees do not feel familiar with the professional identity. A natural consequence is that students or employees will leave the concerned profession (Cech, 2015).

Hannover & Kessels (2004) studied the process of comparing the image of the current self and the image of a group identity, by self-to-prototype matching (STPM). When using STPM, a student lists the characteristics of the self-concept (personal identity) and a prototypical group member (professional identity) and considers the match between these two lists. The higher the congruence between the two, the more likely the student commits or connects to the group.

The importance of the self-to-prototype matching strategy is stressed by several studies. Based on knowledge of the self, and characteristics of a future job, students make choices regarding their profession (e.g., Moss & Frieze, 1993; Rounds, Dawis, & Lofquist, 1987; Taconis & Kessels, 2009). A prerequisite for self-to-prototype matching is having a clear self-concept. Hannover & Kessels (2004) concluded in their study that only students with a strong self-concept, can use self-to-prototype matching in order to make choices.

Using STPM Hannover and Kessels (2004) asked their participants to rate 65 trait adjectives according how well they described a prototype of a specific subject (1 = not being typical at all, 7 = being very typical). Subsequently, the participants had to describe themselves, using the same 65 trait adjectives and rating scale. The current research also offered adjectives to students, but did not use the same stimuli as Hannover and Kessels (2004). Alternatively, participants had to describe their personal identity and the professional identity of an engineer by means of the five categories of Ashforth et al. (2008): *skills, values, personality, goals*, and *interests* (see Figure 1). For each category participants could choose three to five cards with characteristics (based on Möwes, 2016) that could be used to describe the personal identity and professional identity of an engineer. In addition, the current research provided an opportunity to add characteristics by offering empty cards.

Core of the identity. Whereas the content of the identity displays the overlap between the personal characteristics of the self and the profession, the core of the identity is focused on the identification with a certain profession. This identification describes the connectedness of the self with the profession (Pratt et al., 2006) and is reflected in the extent of commitment an individual has with the profession (Ashforth et al., 2008). The level of identification can be measured by questions regarding commitment and affirmation. In previous research, Van Dick et al. (2004) showed that social identification plays an important role in the organizational domain. Also related to organizational psychology is research of Pratt et al. (2006) that showed that identification can be seen as one of the main determinants of a successful career (Pratt et al., 2006). From a more educational scientific perspective, Meijers, Kuijpers, and Gundy (2013) concluded that a well-developed professional identity leads to appropriate choices for education and career, fitting the personal identity. As a result, more appropriate choices leads to a lower rate of dropping out (Wijers & Meijers, 1996) and more successful completion of studies. Also from a social psychological perspective identification has been studied, referring to the original social identity theory of Tajfel and Turner (Turner, 1982). According to Mancini et al. (2015) the (professional) identity is a collective identity and related to intergroup processes, and therefore they tried to capture these social processes in identity development.

Taken it together, this previous research shows the versatility and the importance of identification. Thus, current research uses the variable identification to get insight in the typical career choices of STEM-students that may offer an answer to the question who leaves the technical field and who does not.

Behaviours of identity: the identity status. Current research tries to get insight in the professional identity of STEM-students and their typical career choices. Whereas the content and the core of identity are mainly focused on the internal processes (i.e. self-concept and identification), behaviours of identity is more focused on the associated actions of the individual. The concept identity status, originally introduced by Marcia (1966), bridges the gap between these internal processes (commitment) and behaviours (explorative activities). In other words, identity status is a midway between what Ashforth et al. (2008) would define as the core of identity and behaviours of identity.

As described above, the ego identity theory can be used to describe the development of the identity (Munley, 1977). Marcia (1966) elaborated on the ideas of Erikson and used the concepts *commitment*

and *exploration* to define the professional development of students. During their late adolescence, students explore the occupational and psychosocial options around them to expand their identity (Marcia, 1966). Exploration can be done for example by actively questioning or weighing various identity alternatives and its values, beliefs, and goals. This exploration could be followed by commitment to the specific identity. By commitment, the individual makes a choice about the implementation of a specific identity. To this end, one could argue that this commitment element of the identity status model (Marcia, 1966) connects with the core of identity (Ashforth et al., 2008), whereas the exploration element (Marcia, 1966) matches with behaviours of identity (Ashforth et al., 2008).
Combining the concepts exploration and commitment, Marcia (1966) defined several statuses of identity formation, displayed in the identity status paradigm. Exploration and commitment could be present or absent, and based on that four identity statuses could be identified (see Table 1).

- *Achievement status*. After active exploration of several options, individuals have made a commitment to a specific identity domain.
- *Foreclosure status.* With little or no exploration, individuals have made a commitment to a specific identity domain. For example, a job could be based on recommendations from parents.
- *Moratorium status.* Although individuals actively explored, no commitment is made yet. For example, individuals could try out different jobs in order to find the most suitable one.
- *Diffusion status*. Neither exploration nor commitment occurred. The individual is without job prospects but could not be bothered by it.

Table 1
Four identity statuses of Marcia (1966)

		Commitment	
		Low	High
	Low	Diffusion status	Foreclosure status
Exploration	High	Moratorium status	Achievement status

In order to capture the dynamic process of identity formation, Crocetti, Schwartz, Fermani, and Meeus (2010) made some adjustments to the identity status model by Marcia (1966.). According to Crocetti et al. (2010), with developing a professional identity, individuals do not start with a blank identity, rather there has been a current identity. In other words, with growing older, individuals have already formed a certain identity. So to form a professional identity, the current identity needs to be adapted instead of developing a complete new identity. Therefore exploration is a two-folded process. On the one hand, individuals monitor their present commitments, named *in-depth exploration*. On the other hand, individuals explore alternative commitments and decide whether alternative commitments are superior to the current commitments. This process can be named as *reconsideration of commitment*.
Combining the three processes (in-depth exploration, commitment and reconsideration of commitment) resulted in five identity statuses involving a redefinition of the moratorium status. Crocetti et al. (2010) divided the original moratorium status in moratorium status (low score on commitment, medium score on in-depth exploration, and high score on reconsideration of commitment) and *searching moratorium status* (high score on all three processes). Individuals with the searching moratorium status are seeking to revise the commitments that already have been enacted, whereas individuals with a moratorium status evaluate alternatives in order to find new commitments that are satisfying.

The models of Marcia (1966) and Crocetti et al. (2010) emphasize professional identity from a personal, developmental perspective (ego identity theory) as it is mainly focused on the intra-individual processes individuals go through in their career. Based on the motivational and cognitive processes, the personal talents and abilities of individuals will develop. However, according to Mancini, Panari, and Tonarelli (2015) the professional identity not only consists of a personal, but also a collective identity. This means that the processes of categorization, group identification and social comparison are involved as well; processes that are related to the social identity theory. Therefore Mancini et al. (2015) made an extension on the identity status model with as purpose to combine the intra-individual processes and intergroup processes with the development of professional identity. The processes *affirmation* and *practices* were added. Whereas commitment[1] is about the choices an individual makes, affirmation "captures the importance one attributes to the professional category to which one belongs and the sense of pride one feels as a member of that category" (Mancini et al., 2015, p. 142). Both processes capture the process of commitment. A proud and happy feeling about becoming a profession can sustain the choices students make regarding their profession. Practices was added to extend the process of exploration. It refers to the activities or actions that are directly relevant to a profession in which individuals engage. Whereas in-depth exploration (Crocetti et al., 2010) refers to more cognitive exploration, practices is more related to the behavioural actions that come with exploration (Mancini et al., 2015). These actions contribute to the process of forming a professional identity in two ways. First, it allows students to explore the implications that are related to their career choice. Second, activities support the commitment and identification with the concerned profession. The adaption of Mancini et al. (2015) resulted in the five processes: Affirmation, in-depth exploration, practices, commitment, and reconsideration of commitment. Combining these five processes results in five identity statuses:

- *Achievement*. High score on commitment, in-depth exploration, practices and affirmation, a low score on reconsideration of commitment
- *Foreclosure*. Medium high score on commitment, a high on affirmation and practices, a low score on in-depth exploration and reconsideration of commitment
- *Searching moratorium*. High score on in-depth exploration and reconsideration of commitment, a medium high score on affirmation and practices, and a low score on commitment
- *Moratorium*. Low score on commitment, affirmation and practices, a medium high score on in-depth exploration and a high score on reconsideration of commitment
- *Diffusion*. Low score on all five dimensions

By extending the identity status models of Marcia (1966) and Crocetti et al. (2010), Mancini et al. (2015) demonstrate the importance of two types of exploration (in-depth exploration and practices) and two types of commitment (commitment and affirmation), along with reconsideration of commitment. A full summary of the theoretical enhancements can be found in Figure 2.

Behaviours of identity: the career choice. In sum, Figure 2 represents the theoretical developments of the identity status model. The specific identity status could explain the typical career choices an individual makes. These career choices are also part of behaviours of identity, namely persisting in or leaving the technical field. A logical consequence for a STEM-student with an achievement status is choosing a career in the technical field. In contrast, for a STEM-student with a moratorium status it is not that likely to choose a career in the technical field yet. Pierrakos, Beam, Contstranz, Johri, and Anderson (2009) investigated the career choices of STEM-students and the motivations behind their choices and found some focal points. These focal points are also reflected in the processes that contribute to the identity status. The first focal point is knowledge of the profession. Students can have more or less knowledge about the profession, and this can be gained by knowing an engineer for example. Students with less knowledge of engineering often have misconceptions and had less exposure. This can lead to choosing a non-technical profession. Furthermore, preparedness is a focal point. This describes the interest students have in STEM. Subsequently, this interest could be divided in extrinsic and intrinsic motivation. Students with intrinsic motivation made the choice for the specific study by themselves, whereas students with extrinsic motivations are often pushed towards it by others. With a more intrinsic motivation, it is more likely that a STEM-student will choose for a technical profession. The last focal point is a sense of belonging. Fit and commitment could be created by engaging STEM-related activities and having a social (and professional) network inside engineering (done by practices). More exposure to the technical field can insinuate a career in the technical field.

[1] The original name of the process by Mancini et al. (2015) was *identification with commitment*. For more clarity and consistency in the definition of identity concepts in this research, I chose the name *commitment*.

Pierrakos et al. (2009) noted that although these focal points may not be representative for the entire population, their findings were related to students who persisted and switched. Therefore, these findings could offer some information for the pathways students will follow and the career choices they make

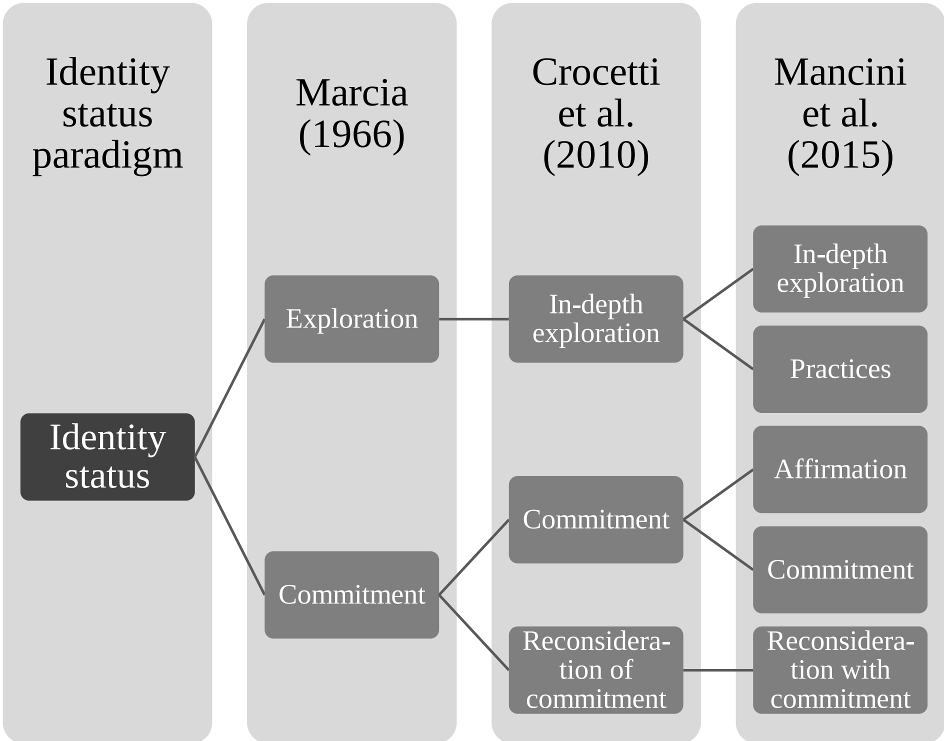

Figure 2. Theoretical developments of the conceptualization of identity status

Current Research

As identification with a profession is one of the main determinants of a successful career (Pratt et al., 2006), the current research indicates the need for more insight in the content of the professional identity of highly educated STEM-students. Diagnosing different types of STEM-students and their typical career choices may offer an answer to the question who leaves the technical field and who does not. In previous research, Taconis and Kessels (2009) found that the match between the self-image and the image of the perceived future as engineer (i.e. prototype) is a predictor for a science-related career choice The current research follows this reasoning and combines several concepts to gather information about the professional identities of STEM-students. To get insight in the content of the professional identity of engineers, the categories of Ashforth et al. (2008) skills, values, personality, goals, and interests are used to discover the different characteristics. As a match between these characteristics and the characteristics of the self is a main determinant for a successful career, STPM could be used to consider the overlap between the self and the prototype. This is an indication of the extent of identification STEM-students have with their future profession. To support this in a more quantitative way, the items of the identity status paradigm of Mancini et al. (2015) could be used to measure the level of identification and to indicate the status of identity formation. Combining all these concepts leads to a research model that is explained below (Figure 3).

Research Question and Model

To investigate the professional identity of STEM-students, both qualitative and quantitative methods are used. The research consists of a qualitative part and a quantitative part. First the qualitative part is described. In order to guide research, the following research questions are posed:

1. What are the typical characteristics that form the personal identity of STEM students?
2. What are the typical characteristics that form the professional identity of an engineer?

Also on a more exploratory level, I am interested in the type of activities students undertake to explore their career interest. Thus, a third research question is;

3. What activities do students currently undertake to explore their career interests?

On a more quantitative level, the extent to which STEM-students current self-perceptions match with their perceived future as engineer is measured by the fourth and fifth research questions:

4. To what extent does the personal identity of STEM-students match with their perceived professional identity as future engineer?
5. To what extent does the level of overlap between the personal self – and professional engineer positively relate to the level of identification as engineer?

Lastly, several concepts will be combined. The relationship between the level of identification with the profession and the current identity status and intended career choice will be measured. Also the relation between the identity status and the career choice will be discovered. This results in the last research questions:

6.1 What is the relationship between the level of identification with the profession and the current identity status?

6.2 What is the relationship between the level of identification with the profession and intended career choice?

7. How does the identity status relate to the career choices of STEM-students?

The conceptual model (Figure 3) of the quantitative part of the current research is formed by the three formulations of Ashforth et al. (2008). The content of the personal identity and the professional identity of an engineer and the accompanying overlap score covers the content of identity. The core of the identity is formed by the level of identification with an engineer. Finally, the identity status and career choice display the behaviours of identity.

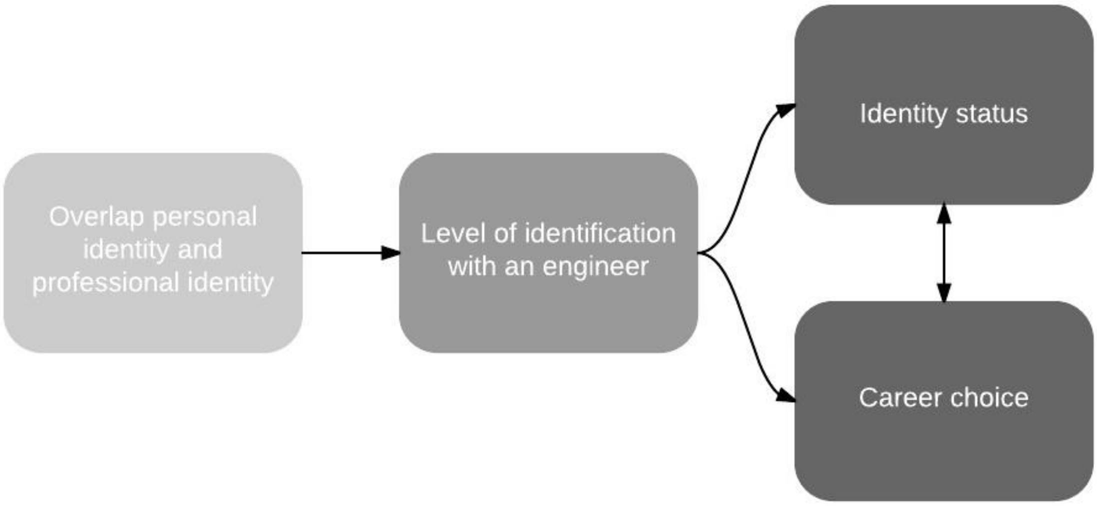

Figure 3. Research model

Method

Research Design

The research had a mixed-method design (Leech & Onwuegbuzie, 2009) with a qualitative component and a quantitative component. The qualitative research component consisted of a description of the content of the personal identity and professional identity of engineers and accompanying activities, using a card-sorting activity (Babbie, 2010). The quantitative part of the research focussed on testing relationships between the variables of the study displayed in Figure 3.

Participants

The target population consisted of highly educated STEM-students. To select participants, non-random sampling with maximum variation was used (Onwuegbuzie & Leech, 2007) in order to capture the large variation of different STEM-students and their typical characteristics. Participating students were following the third year of their bachelor program at the University of Twente, or the University of Applied Sciences (Saxion). At this point in their studies, students have to start making decisions regarding their master program and/or career. Students in the first or second year of the bachelor were excluded because they have not had sufficient exposure to technical field yet (i.e., internships). Students in their fourth year of the bachelor or master students were excluded because of the fact that they already made some crucial decisions regarding to their future profession. In addition, these students were less accessible due to internships.

Table 2

Distribution of the participants over the study programs

Name Study *	University of Applied Sciences	University	Total
Technische Informatica[a]	3		3
Electrical Engineering[a]	9	12	21
Werktuigbouwkunde[a]	1	1	2
Chemische Technologie[a]	1		1
Advanced Technology[a]		3	3
Civiele Techniek[a]		9	9
Industrieel Product Ontwerp[b]	12		12
Technische Bedrijfskunde[b]		8	8
Total	26	34	60

Note. * = to capture the uniqueness of the studies, the original Dutch name was used.
[a] cluster 1 study. [b] cluster 2 study.

The sample consisted of 60 participants, (86.7% men). The mean age of the students was M_{age}= 21.43 (*SD* = 1.75). In total, 26 students studied at University of Applied Sciences, 34 students studied at the University. The average number of attained EC's was $M_{EC's}$ = 129.42 (*SD* = 19.08) in December 2015 and January 2016.

In the Netherlands, technical study programs are classified into four clusters. Cluster 1 contains educational programs within the sectors nature and science. Cluster 2 studies are programs outside the nature- and science sector but have > 50% beta-technical courses. Cluster 3 includes programs for science teachers. Finally, cluster 4 consists of programs with < 50% technical courses (Volkerink, Berkhout, & De Graaf, 2010). By using maximum variation to select the participants, both students from cluster 1 and cluster 2 were approached, this resulted in a broad sample. Cluster 1 included 66.7% of the participants (33.3% Cluster 2). Initially, only students studying Industrial Engineering and Management, Civil Engineer or Electrical Engineering were approached. More studies were added to achieve maximum variation and a sufficiently large sample. An overview of the distribution of the studies can be found in Table 2.

Instrumentation

Both qualitative and quantitative data was gathered with a questionnaire. The measured concepts are displayed in Table 6. The paper-and-pencil questionnaire was supplemented with a card-sorting activities. In addition to the measured variables of the study, questions about the demographic background of the participants were added.

Overlap professional and personal identity. Both the content of the personal identity and the content of the professional identity of engineers was measured by a card sorting activity. The initial idea was to work with a bottom-up approach, from a more grounded theory perspective. This process entailed that participants had to name characteristics to describe them, or the typical engineer, in each of the five categories based on Ashforth et al. (2008). During the pilot-version however, it appeared that this approach did not work well, as it was experienced too difficult by the participants. Therefore, in the final version of the questionnaire stimuli were given. Based on Möwes (2016), each of the categories included 28 to 44 cards with characteristics. For each category they had to choose three to five cards. An example of this activity can be find in Appendix 1. With a bottom-up approach in mind, they could use empty cards to write down specific characteristics that were not included in the presented cards.

First, participants chose the cards in order to form their personal identity. Second, they chose cards to describe the professional identity of an engineer. The cards the participants chose, gave an overview of the content of the personal identity and the professional identity of an engineer. To construct the quantitative variable overlap, for each category an overlap score was generated. In addition, an overall overlap score was generated.

Level of identification with an engineer. In order to measure the level of identification with an engineer, seven items adopted from the processes commitment and affirmation from the identity status paradigm of Mancini et al. (2015) were used. The reason to use these items for both measuring level of identification and the processes affirmation and commitment was because of the conceptual overlap. Questions about identification and affirmation and commitment had such overlap that participants saw this as duplication. In order to facilitate the questionnaire, it was decided to use the items for measuring two variables. An example of an item from the variable level of identification was: 'Thinking of myself as an engineer makes me feel self-confident'. Participants filled in to what extent the propositions suited them by means of a five-point Likert scale (1 = totally disagree, 5 = totally agree). A sum score indicated the level of identification with an engineer. The reliability of this scale was high, α =.84.

Table 3

Example questions of the five categories adapted from Mancini et al. (2015)

Category	Question
Affirmation	I am looking forward to become an engineer
In-depth exploration	Do you ever think about the advantages and disadvantages associated with becoming an engineer?
Practices	Do you ever participate in meetings/conferences where professional engineers speak?
Commitment	Thinking of myself as an engineer makes me feel self-confident
Reconsideration of commitment	If I could change my choice of becoming an engineer, I would do that

Table 4

Summary of exploratory factor analysis results for the SPSS identity status questionnaire (N=60)

Item	Rotated factor loadings			
	Level of identification	Reconsi-deration of commitment	Practices	In-depth exploration
Thinking of myself as an engineer makes me feel secure in my life	.79			
Thinking of myself as an engineer makes me feel self-confident	.79			
Thinking of myself as an engineer helps me to understand who I am	.74			
It is important for me to become an engineer	.73			
I am proud to become an engineer	.71			
I am looking forward to become an engineer	.60			
I am feeling good at this moment in time as future engineer	.50			
If I could change my choice of becoming an engineer, I would to that		.78		
I think that it would be better to prepare myself for another profession		.74		
I am considering the possibilities of changing my study program in order to be able to practice another profession		.74		
I think choosing a different profession would make my life more interesting		.58		
Do you ever read books/articles written by engineers?			.89	
Do you ever participate in meetings/conferences where professional engineers speak?			.74	
Do you ever seek information about the regulations of the engineering practice?			.74	
Do you ever think about the advantages and disadvantages associated with becoming an engineer?				.77
Do you pay attention to what other people say about engineers?				.73
Eigenvalues	3.50	2.40	2.22	1.72
% of variance	21.89%	15.00%	13.86%	10.76%
α	.84	.70	.76	
r				.36*

Note. * = $p < .01$

Identity status. During the pilot version, questions from Crocetti et al. (2010) were used to measure the identity status of the participants. During the process of piloting, a new version of the identity status model by Marcia (1988) and by Crocetti et al. (2010) was published. Therefore, it was decided to use the questionnaire by Mancini et al. (2015), adapted to the current research purposes. Participants answered 19 questions that were divided in five categories: commitment (four questions), affirmation (four questions), practices[2] (three questions), in-depth exploration (four questions), and

[2] In the questionnaire by Mancini et al. (2015), the subscale ‘practices’ consisted of four questions. However, since the current survey already contained an open question about the activities students undertake to discover the professional field, the question ‘I seek information about the different job options that a degree in engineering may offer’ was deleted.

reconsideration of commitment (four questions). For each category, an example question can be found in Table 3. A five-point Likert scale was used to give answers (1= totally disagree, 5 = totally agree) for the answers in the categories commitment, affirmation, and reconsideration with commitment. Also the questions in the categories practices and exploration were answered by a five-point Likert scale (1 = never, 5 = very often).

To investigate the internal structure of the identity status questions, exploratory factor analysis was conducted using a Principal Component Analysis with oblimin rotations. Initially, the factor analysis with the 19 questions, yielded with an extraction of 5 factors with eigenvalue >1. A total of three items were eliminated because they failed to meet a minimum criteria of having a primary factor loading of .4 or above, and no cross-loading of .3 or above. Specifically, the item 'Thinking of myself as an engineer makes me feel confident about the future' and 'Do you ever wonder whether the profession of engineering is the most suitable for you' had factor loadings between .30 and .50 on two factors. In addition, the item 'Are you ever concerned of becoming an engineer' did not load above .40 on any factor. The items of commitment and affirmation all had a loading of .50 or above on the same factor, therefore commitment and affirmation were combined to one factor *level of identification*.

A final factor analysis based on principal component analysis (PCA) with the remaining 16 items, using oblimin rotation, was conducted. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, $KMO = .64$. Bartlett's test of sphericity χ^2 (120) = 369.70, $p < .01$, indicated that the correlations between items were sufficiently large for PCA. Oblimin rotation resulted in four interpretable factors, labelled level of identification, in-depth exploration, reconsideration of commitment, and practices, all with eigenvalues >1.00, explaining in total 61.51% of the variance. See Table 4 for rotated factor loadings. A reliability analysis was conducted for level of identification (α = .84), reconsideration of commitment (α = .70), and practices (α = .76). As the category in-depth exploration consisted of two items, a correlation was measured, r (60) = .36, $p < .01$. An $r > .30$ can be seen as a medium effect size, therefore the correlation between the two items of in-depth exploration was sufficient (Ellis, n.d.).

Table 5
Concepts demographic background

Concept	Possibilities for answering
Gender	male/female
Nationality	Dutch/other
Age	open question
Living situation	at parents' house / students' house
Secondary education	VMBO / HAVO / VWO / Gymnasium
Profile secondary education	societies and cultures / societies and economy / nature and health / nature and technology / other
Previous study	yes/no
Name current study	open question
Student level	bachelor student Saxion / bachelor student UT / master student UT
Year of study	open question
Number of EC's	open question
Start of current study	open question
Internship	yes / no
Active member at a study association	yes / sometimes / no
Year of finishing study	open question

Career choice. Three questions in the questionnaire were related to the career choice of the participants. Two open questions ('Please give an example of function you would like to perform in the future' and 'Please give an example of an organization you would like to work in the future') were used to discover the favoured future profession and the favoured future organization. These two questions were quantified by one researcher by dividing the answers in technical and non-technical profession and organization. For example, ‘designer’ was labelled as a technical function, whereas ‘project leader’ was labelled as non-technical function as the job is mainly focussed on managing and controlling and less on designing.

Career exploration activities. To list the activities students undertake to discover the professional field an open question was asked: ‘What activities do you undertake to discover what kind of work you want to do after graduating’. All answers were entered in Atlas.ti, coded and categorized.

Demographic background. In order get insight in the student background information, additional questions about the student and its study were added. Concepts are displayed in Table 5.

Procedure

Before the data collection, that took place form December 2015 till the end of January 2016 could start, participants of the University of Twente and Saxion had to be selected. Participants of the University of Twente were recruited personally and the snowball method was used to approach more students from the University of Twente. Besides, participants of Saxion were recruited via a contact person and personal contact during project hours. The participation was voluntary and all participants made a personal appointment with the researcher to fill in the questionnaire. Most participants had an individual appointment, some participants had an appointment in duos, but also filled in de questionnaire individually.

During an appointment participants filled in the questionnaire. The questionnaire started with a spoken and written informed consent about the purpose of the study, the process, risks and benefits and the use of the results. After a written confirmation of participation, the participants started with part 1 and described their personal identity according to the five categories of Asforth et al. (2008) with a card-sorting activity. This was followed by part 2 that consisted over the demographic characteristics of the participant and part 3 with questions about the participant’s study. In part 4 participants performed again a card-sorting activity based on the five categories of Asforth et al. (2008) again, but this time they described the professional identity of an engineer. Part 5 was formed by questions about the affirmation participants had with their future profession. The questionnaire was completed by part 6 with some final questions about the research. Completing the questionnaire took about 30 minutes per person. All participants were personally supported by the researcher in case they had questions. As a thanks, participants received a gift voucher of five euros.

The research was performed according to the ethical guidelines of the University of Twente. Before the data collection started, an ethical form was filled in and approved by the ethical committee of the University of Twente. As mentioned above, an informed consent took place before the participants started with filling in the questionnaire. A debriefing session was not needed as the participants were fully informed prior to the study, and the risk of stress or discomfort was minimal. The anticipated benefits of participating were higher than the risk. In addition, there was no question of a relation of dependency between the researcher and the participants. However, in contrast to a positivism perspective, the researcher was involved with the participants as it was a one-to-one situation. The researcher did not had a distanced role, but created a workable atmosphere for the participants in order to complete the questionnaire (Mertens, 2014). The data was handled confidentially, as the names of the participants were not used in any published or written material concerning the research. Only the researcher and the supervisors had access to the interview materials (Babbie, 2010). Participants could fill in the e-mail address to receive their personal and general results of the research.

Table 6

Measured components of the research

Component of the study	Measured concepts	Measured by	Example question	Measurement level
Overlap personal identity and professional identity	The content of the personal identities and the future professions consisting of the 5 categories of Asforth et al. (2008) - Interests - Competences - Values - Personality - goals	3 to 5 answers per category compared with the Self-to-prototype-matching strategy of Hannover and Kessels (2004)		String (Open questions)
Level of identification with an engineer	Identification score	7 questions of the categories commitment and affirmation of Mancini et al. (2015)	“Becoming an engineer is important for me”	Interval (Likert scale: 1 = totally disagree, 5 = totally agree)
Identity status	Individual identity status of the participants: - Achieved - Foreclosed - Diffused - Searching moratorium - moratorium	A final score compromised by the scores of the 4 categories: - Identification (7 questions) - Practices (3 questions) - In-depth exploration (2 questions) - Reconsideration of commitment (4 questions)	“I think another profession would make my life more interesting”	Nominal (Likert scale: 1 = totally disagree, 5 = totally agree)
Career choice	- Future profession - Future organization	2 open questions about the future profession	“Please give an example of an organization you would like to work in the future”	String (open question)
Career exploration activities	- Undertaken activities	1 open question about the activities students undertake to explore the professional field	“What activities do you undertake to discover what kind of work you want to do after graduating?”	String (open question)

Results

The current research aimed to understand what constitutes the professional identity of STEM-students and how this affects their future career choices. The first goal of the study was to describe the content of STEM-students' personal and future professional identity. Secondly, the activities that students undertake to discover their professional field were investigated. For the quantitative part, the purpose was to measure the extent to which STEM-students' current self-perceptions match with their perception of their future profession engineer. In addition, the relationship the overlap between the personal identity and the professional identity was investigated. Subsequently, the relationship between the level of identification with an engineer and the identity status and the relationship between the level of identification with an engineer and the career choice was measured. Lastly, the relationship between identity status and career choice is analysed. Because of the qualitative and quantitative research questions, both qualitative and quantitative analyses were performed. The description of the data-analyses is divided in a qualitative part and a quantitative part.

Qualitative Research Questions

Content of the personal identity of STEM-students and the professional identity of an engineer (RQ 1 and RQ2). In order to list the typical characteristics that form the personal identity of STEM-students and the professional identity of an engineer, all the cards that the participants individually chose to describe these identities, distributed over the five categories, were gathered and entered in the program Atlas.ti. Subsequently the amount of cards for the personal identity and the professional identity of an engineer were calculated. In addition, two ranking lists of most common characteristics per category were made.

For each category, participants could choose five cards, which led to a maximum of 300 of all the participants together. For describing the personal identity participants chose *M* = 23.08 cards (*SD* = 2.19). To describe the professional identity participants chose *M* = 22.28 cards (*SD* = 2.42). Table 7 presents the average amount of cards that participants chose for the separate categories of the personal and professional identity. The averages are close to each other, with a highest amount for 'personality' for personal identity (*M* = 4.80, *SD* = .44) and 'skills' for professional identity (*M* = 4.80, *SD* = .44). The category 'interests' for the professional identity has the lowest mean (*M* = 4.02, *SD* = .81).

Table 7
Means chosen cards for personal and professional identity

	Personal identity		Professional identity	
Category	*M*	*SD*	*M*	*SD*
Skills	4.53	.65	4.80	.44
Values	4.78	.45	4.70	.59
Personality	4.80	.44	4.65	.61
Goals	4.32	.77	4.12	.85
Interests	4.65	.63	4.02	.81

Next to the number of used cards to describe the identity, there was some variation in the specific characteristics that were chosen (Table 8). Except for the categories values and goals there was a wider variation in the choice of characteristics to describe the personal identity than for the professional identity. This seems logical, as the personal identity described the unique individual and the professional identity a prototype engineer. However, the numbers of the used chards did not differ a lot. Whereas participants used almost every card to describe the identity of an engineer for the scale skills, participants did use less cards for personality. This may partly due to the fact that this scale, contrary to the other scales, contained negative characteristics. In Appendix 2 an overview can be found.

Table 8

Used characteristics to describe the professional identity

Category	Number of characteristics per category	Used characteristics for personal identity	Used characteristics for professional identity
Skills	39	37 (94.87%)	35 (89.74%)
Values	44	36 (81.82%)	39 (84.64%)
Personality	44	35 (79.55%)	32 (72.73%)
Goals	28	22 (78.57%)	25 (89.29%)
Interests	28	24 (85.71%)	23 (82.14%)

In Table 9 an overview of the 10 most common characteristics per category are displayed for both personal identity and professional identity. For personal identity, 50% of the participants chose *enjoying life* while it was not placed in the top 10 of the identity of an engineer. In fact, only 3.33% chose enjoying life for describing the identity of an engineer. The goals *be someone people go to for advice* and *be able to do things in my own way* were popular for both personal and professional identity. Most similarities in the two ranking lists were found in the category skills (7), whereas goals and values showed less similarities (respectively 2 and 4). Further investigations and accompanying discussions can be found in the conclusion and discussion.

Looking closer to the professional identity, the most popular characteristics, chosen by >50% of the participants were *practical* (31), be able to do things in my own way (37), be someone people go to for advice (30), *building and repair* (45), and *computer activities* (35). These characteristics belong to the categories 'personality', 'goals' and 'interests'. For the categories skills and values there was less consensus, and so the numbers of cards that are most chosen are lower. In the category skills *designing systems and products* and *developing solutions for complex problems* were most popular with respectively an amount of 26 and 25. In the category values *challenge* and *being responsible* were post popular with respectively an amount of 27 and 23. Since the amount of *decision making* and *leadership and managing* in the category skills for professional identity was equal, both characteristics were added in the top 10.

Table 9

Ranking of the personal characteristics (N=60)

	Personal identity			Professional identity		
Category	Characteristic	Amount	%	Characteristic	Amount	%
Skills	Listening to others	19	31.67%	Designing systems and products	26	43.33%
	Developing solutions to complex problems	14	23.33%	Developing solutions to complex problems	25	41.67%
	Leadership and managing	13	21.67%	Analysing problems	21	35.00%
	Math, science, and engineering	13	21.67%	Thinking analytically	20	33.33%
	Decision making	11	18.33%	Project-based working	20	33.33%
	Thinking critically	11	18.33%	Thinking critically	18	30.00%
	Thinking analytically	11	18.33%	Putting math, science, and engineering knowledge into practice	17	28.33%
	Adapting to changing conditions	10	16.67%	Math, science, and engineering	17	28.33%
	Collaborating with peers	10	16.67%	Collaborating with people outside my own discipline	14	23.33%
	Designing systems and products	10	16.67%	Decision making	12	20.00%
Values	Enjoying life	30	50.00%	Challenge	27	45.00%
	True friendship	21	35.00%	Being responsible	23	38.33%
	Fun	17	28.33%	Curiosity	17	28.33%
	Curiosity	16	26.67%	Intellectual stimulation	15	25.00%
	Challenge	16	26.67%	Regularity and order	15	25.00%
	Freedom	15	25.00%	Social recognition	15	25.00%
	Living up to my full potential	14	23.33%	Living up to my full potential	15	25.00%
	Helping people	12	20.00%	Job security	12	20.00%
	Social contacts	11	18.33%	Success	11	18.33%
	Equality	10	16.67%	Helping people	11	18.33%
	Good health	10	16.67%			
Personality	Honest	27	45.00%	Practical	31	51.67%
	Friendly	20	33.33%	Precise	27	45.00%
	Ambitious	17	28.33%	Ambitious	27	45.00%
	Practical	16	26.67%	Critical	27	45.00%
	Competitive	15	25.00%	Open-minded	22	36.67%

	Enthusiastic	14	23.33%	Rational	18	30.00%
	Optimistic	13	21.67%	Self-disciplined	14	23.33%
	Open-minded	11	18.33%	Careful	14	23.33%
	Self-assured	11	18.33%	Enthusiastic	11	18.33%
	Critical	10	16.67%	Honest	9	15.00%
Category	Characteristic	Amount	%	Characteristic	Amount	%
Goals	Have a satisfying marriage/relationship	27	45.00%	Be able to do things in my own way	37	61.67%
	Be someone people go to for advice	27	45.00%	Be someone people go to for advice	30	50.00%
	Be able to do things in my own way	24	40.00%	Having routine and structure	28	46.67%
	Be who I really am	24	40.00%	Be an authority in my field of work	24	40.00%
	Be in a good physical condition	20	33.33%	Have an impact on what other people do	18	30.00%
	Have harmonious relationships with my parents and siblings	15	25.00%	Be a leader	15	25.00%
	Make my parents proud	14	23.33%	Have a high standard of living	13	21.67%
	Physical exercise	12	20.00%	Be who I really am	11	18.33%
	Own my own business	11	18.33%	Have a prestigious job	9	15.00%
	Have children	10	16.67%	Own my own business	8	13.33%
	My choices to be based on my true values	10	16.67%			
Interests	Community involvement	25	41.67%	Building and repair	45	75.00%
	Travelling	24	40.00%	Computer activities	35	58.33%
	Music	24	40.00%	Socializing	19	31.67%
	Team sports	20	33.33%	Community involvement	14	23.33%
	Building and repair	17	28.33%	Reading	14	23.33%
	Entertainment	17	28.33%	Travelling	13	21.67%
	Computer activities	17	28.33%	Team sports	12	20.00%
	Partying	17	28.33%	Entertainment	9	15.00%
	(Board)games	14	23.33%	Collecting	8	13.33%
	Adventure sports	13	21.67%	Politics	8	13.33%

Career exploration activities (RQ 3). All the answers on the open question 'What activities do you undertake to find out what kind of work you want to do after graduating?' were entered in Atlas.ti. All answers were categorized and coded. Subsequently an overview list was made with the most common career exploration activities. The category *remaining* was created for activities that could not be administered at another categories. Some examples of activities that are associated with the category remaining are *trying things*, *committees* and *sorority*. From all the participants, four STEM-students stated that they do not perform career exploration activities. The average number of activities that participants noted was *M* = 1.87 (*SD* = 1.03). Under the 56 participants *visiting business fairs* were most popular (16.67%) followed by *visiting companies* (15.00%). Also *internships* were popular (14.17%). Sharing information with fellow students is not popular; *conversations with fellow students* is mentioned only four times (3.33%). In Table 10 an overview of the career exploration activities can be found, divided over the categories *practice*, *study*, and *personal*.

Table 10
List of career exploration activities by STEM-students (N=60)

Category	Proportion of the total	Career exploration activities	Number of times mentioned
Practice	55.00%	Visiting business fairs	20 (16.67%)
		Visiting companies	18 (15.00%)
		Internships	17 (14.17%)
		Conversations with professional engineers	11 (9.17%)
Study	23.33%	Activities study association	13 (10.83%)
		Deepening study	11 (9.17%)
		Conversations with fellow students	4 (3.33%)
Personal	21.67%	Searching for information	13 (10.83%)
		Remaining	7 (5.83%)
		None	6 (5.00%)

Quantitative Research Questions

To measure to what extent the personal identity of STEM-students match with their perceived professional identity as future engineer (RQ 4), and to what extent this overlap relate to the level of identification as engineer (RQ 5), quantitative analyses were performed. In addition quantitative results were used to indicate the relationship between the level of identification as engineer and the identity status and career choice (RQ 6.1 and RQ 6.2) and how the identity status of STEM-students relate to their career choice (RQ 7). First, general descriptive statistics will be presented. Thereafter cross-sectional analyses will be discussed, structured by the research questions.

Descriptive statistics. Descriptive statistics are presented in Table 11. To calculate the overlap scores between self and group ratings on professional identity content, the amount of characteristics of the personal identity and the amount of characteristics of the professional identity were compared and a total overlap score was calculated. The mean of the total overlap score was *M* = 6.02 (*SD* = 3.96).

An overlap score between the characteristics of the personal identity and the professional identity was measured. The mean score on overlap was *M* = 6.02 (*SD* = 3.96), a maximum overlap score of 25.00 was possible. Interests showed the greatest overlap with a mean of *M* = 1.58 (*SD* = 1.17), and values had the smallest overlap (*M* = .95, *SD* = 1.00). For each category a maximum score of 5.00 was possible. However, the differences between the five categories are small. Also mean scores for the processes to define the identity status were measured. Reconsideration of commitment showed has the highest score with *M* = 4.05 (*SD* = .66). Participants had a mean score of *M* = 2.23 (*SD* = .78) on in-depth exploration. Table 12 presents the correlations between the measured variables. All individual overlap scores show a strong significant correlation with the total overlap score as expected. Some remarkable correlations should be mentioned, all (marginal) significant.

When STEM-students indicate an overlap in their personal skills and the skills of an engineer, they are less tended to explore the professional field by practices (*r* = -.34). Same goes up for goals; with a higher overlap on goals, students score less on in-depth exploration (*r* = -25). The total score of overlap is negatively correlated to the level of identification (*r* = -.25), something that will be discussed further in the results of research question four. The total score of overlap is also negatively related to in-depth exploration. Just like with skills, students who experience overlap in their personal identity and the identity of an engineer are less tempted to do some exploration by practices (*r* = -.34). By contrast, students who do identify with an engineer have a higher score on in-depth exploration' (*r* = .28) and practices (*r* = .38). In contrast with the expectations, students with a high score on level of identification have also a high score on reconsideration of commitment (*r* = .22).

Table 11
Descriptive statistics (N=60)

Variable	*M*	SD	Minimum	Maximum
Overlap skills	1.13	1.11	.00	4.00
Overlap values	.95	1.00	.00	5.00
Overlap personality	1.13	1.20	.00	5.00
Overlap goals	1.22	1.12	.00	4.00
Overlap interests	1.58	1.17	.00	5.00
Overlap total	6.02	3.96	.00	22.00
Level of identification	3.44	.63	2.00	5.00
In-depth exploration	2.23	.78	1.00	4.00
Practices	2.66	.90	1.00	5.00
Reconsideration of commitment	4.05	.66	2.25	5.00

Table 12

Bivariate correlation between the variables

	Correlations									
	1	2	3	4	5	6	7	8	9	10
1.Overlap skills	1	.40**	.29*	.37**	.36**	.68**	-.19	-.12	-.34**	-.03
2.Overlap values		1	.41**	.34**	.48**	.72**	-.20	-.09	-.20	-.08
3.Overlap personality			1	.29*	.39**	.69**	-.11	-.21	-.04	.002
4.Overlap goals				1	.46**	.69**	-.25 ☨	-.38**	-.05	.002
5.Overlap interests					1	.75**	-.14	-.10	-.10	-.05
6.Overlap total						1	-.25 ☨	-.26*	-.20	-.04
7.Level of identification							1	.28*	.38**	.22☨
8.In-depth exploration								1	-.07	.04
9.Practices									1	.22
10.Reconsideration of commitment										1

Note. ** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).
☨ = Marginal significant

Cluster analysis identity status. In order to determine students' career status, a *k*-means cluster analysis was performed to group the participants into five homogenous sub-groups based on scores on in-depth exploration, practices, level of identification and reconsideration of commitment. The cluster solution is described in Figure 4, which reports the mean values for the four dimensions for each cluster (standardized scores are reported in order to increase reliability). The found clusters were compared to the clusters of Mancini et al. (2015), displayed in Figure 5. Categories have the same layout, however, in the current research was chosen to merge affirmation and identification to one category, level of identification.

Clusters were generally consistent with the identity status clusters derived from Mancini et al. (2015). Based on this information it was decided to name the clusters just like Mancini et al. (2015) did. However, some differences could be mentioned. While Mancini et al. (2015) found a negative score on practices for the diffusion status. Participants in the current study with a diffusion status scored positive on practices. Second cluster is moratorium. Unlike results of Mancini et al. (2015), participants had a negative score on in-depth exploration. Achievement is the third cluster. In accordance with the cluster of Mancini et al. (2015), participants had a high score on level of identification and a low score on reconsideration of commitment but scored low on practices. Searching moratorium is the fourth cluster and these scores deviate from the scores of Mancini et al. (2015). Participants in the current sample had a low score on practices and a less positive score on the level of identification. Lastly, the fifth cluster is foreclosure and the scores are substantially the same as the scores of Mancini et al. (2015).

Some striking results should be mentioned. Except for the cluster foreclosure, a general low score on practices is found. This applies the same for in-depth exploration, with a general low score, except for the clusters achievement and searching moratorium. Many participants seemed to be committed to a technical career without specific exploration. Most participants were in the cluster searching moratorium. This cluster shows that people did identify with a career in engineering, however they also considered alternative possibilities outside the technique. In addition they performed little career exploration activities.

The ANOVA table (Table 13) indicated if the categories significantly differentiated between the different clusters. Practices ($F(4,55) = 10.512$, $MSE = 6.391$, $p < .01$) has a large mean square error and a low F statistic, which means that this category differentiated less over the several clusters than for example reconsideration of commitment ($F(4,55) = 20.817$, $MSE = 8.883$, $p < .01$). In other words, although participants had different identity statuses, the scores on practices did not show a major difference, however the difference is relevant.

Table 13

ANOVA Cluster Analysis of Identity Status

	Cluster		Error			
	MS	*df*	*MS*	*df*	*F*	*p*
Exploration	8.054	4	.487	55	16.537	.000
Practices	6.391	4	.608	55	10.512	.000
Level of Identification	8.617	4	.446	55	19.317	.000
Reconsideration of Commitment	8.883	4	.427	55	20.817	.000

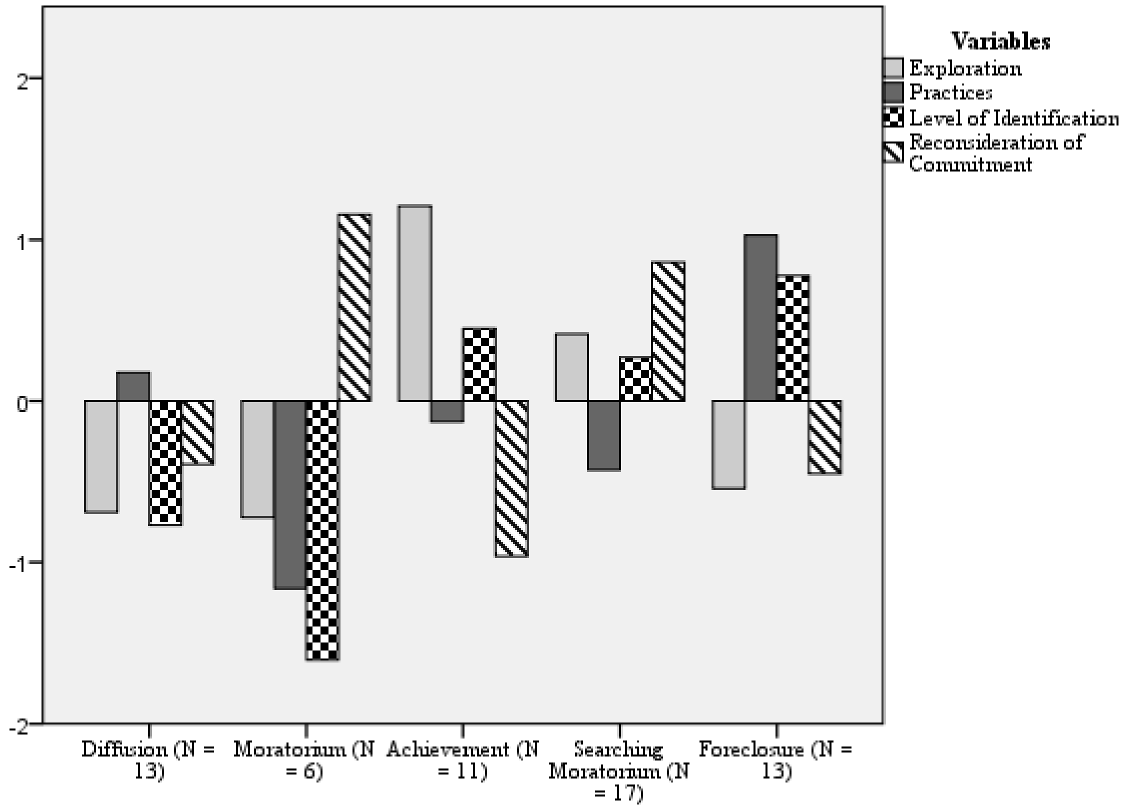

Figure 4. Mean values of the five identity status clusters

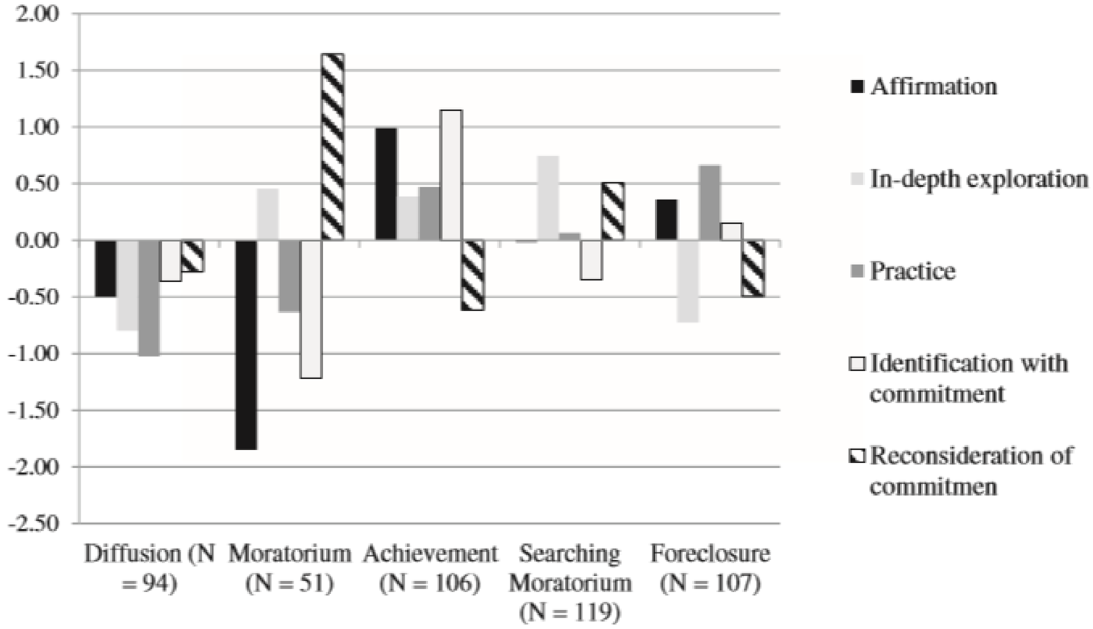

Figure 5. Mean values of the five identity status clusters of Mancini et al. (2015).

Career choice. Participants described their preferred future function and gave an example of an organization they would like to work. Answers were quantified and divided in technical and non-technical. It appeared that 47.2% of the participants does not prefer a technical function. To investigate the relations between function and organization a Chi Square analysis was conducted (Table 14). Results of the Pearson Chi Square showed a significant relation between the function and organization, $N = 53$, $\chi^{(1)} = 7.528$, $p < .01$, $\phi = .377$. Results showed that 47.20% preferred a technical function in a technical organization. Conversely, 20.80% preferred a non-technical profession outside the professional field. Further interpretations and conclusions will be discussed in the conclusion and discussion.

Table 14

Cross Tab for function and organization (N=53)

		Organization		
		Technical	Non-technical	Total
Function	Technical	47.2% (38.9%)	5.7% (14.0%)	52.8%
	Non-technical	26.4% (34.7%)	20.8% (12.5%)	47.2%
	Total	73.6%	26.4%	100%

Note. Subscripted percentage is expected count.

Cross-sectional analysis. Results in relation to the quantitative research questions can be found in the following part. The descriptive statistics presents some basic information about the research variables. In the cross- sectional part, results regarding the research questions will be discussed. First, the relation between the overlap score and the level of identification (RQ 5) will be discussed. Subsequently, research questions five and six will be answered. Lastly, results of research question seven and some additional analyses about the relation of the student level and career choice will be presented.

Relation between overlap score and level of identification (RQ 5). Current study aimed to indicate the relation between the overlap score and the level of identification. Before a regression analysis was performed, overlap scores (RQ4) were measured. These overlap scores could be found in the descriptive statistics. The R^2 and adjusted R^2 were analysed to estimate to what extent the level of identification can be predicted by the overlap between the personal and professional identity. Results showed a small marginal significant relation between the total overlap score and the level of identification ($F(1, 58) = 3.73$, $p = .058$), with an R^2 of .06. Contrary to previous results, the overlap score was negatively correlated with the level of identification ($\beta = -.25$), indicating that participants with a greater overlap between the personal identity and the professional identity tended to have a lower level of identification with an engineer.

For further investigation if the single overlap scores of the five categories correlate to the level of identification, a multiple regression analysis was conducted (Table 15). The multiple regression model with all five predictors produced $R^2 = .08$, $F(5, 54) = .97$, $p > .05$. Except for the overlap scores on personality and interests, all overlaps scores had a negative impact. This implies that participants that had overlap in the characteristics of their personal identity and the professional identity, less identified with an engineer. However, these impacts were not significant ($p > .05$).

Relation level of identification and identity status (RQ6.1). A multinomial logistic regression was performed to determine how the level of identification related to the five identity statuses of STEM-students. Nagelkerke's R^2 was used to analyse the effect size measures for the model. Besides, to analyse how the level of identification effects the identity status, *B* (odd's ratio) was used. First must be determined whether the variation between the level of identification and the several identity statuses was random or systematic. The intercept only model assumed only random errors and therefore this model was compared to the model that assumed systematic variation between the level of identification and the several identity statuses. Comparing the intercept model and the final model, model fit indices and log likelihood indicated indeed systematic variation (Δ AIC = 133.31, Δ BIC = 42.28, Δ -2LL = 58.66), which means that the variation was not random. Pearson and deviance statistic test were both not significant, indicating sufficient model fit. Nagelkerke R^2 showed that the model explained 65.3% of the variance. Analysis of the individual identity status revealed that the level of identification significantly influenced the identity status of STEM-students, displayed in Table 16.

Table 15

Effects of the separate overlap score on the level of identification

	Unstandardized Coefficients		Standardized Coefficients		
	b	SE	β	t	Sig.
(Constant)	3.669	.152		24.061	.000
Overlap skills	-.047	.085	-.083	-.557	.580
Overlap values	-.073	.100	-.116	-.730	.468
Overlap personality	.008	.079	.015	.098	.922
Overlap goals	-.111	.086	-.196	-1.291	.202
Overlap interests	.015	.086	.027	.168	.867

a. Dependent variable: level of identification
b. R^2 = .08

Table 16

Influence of the predictor level of identification on the identity status

	Model fitting criteria			Likelihood ratio tests		
Effect	AIC of reduced model	BIC of reduced model	-2 Log likelihood of reduced model	Chi-square	df	Sig.
Intercept	133.31	141.69	125.31	54.81	4	.00
Level of identification	137.164	145.54	129.16	58.66	4	.00

In addition, the magnitude and direction of the influence of the level of identification on the identity status was analysed. The moratorium status served as reference category, which means that the other statuses were compared to the moratorium status in terms of the extent of level of identification. Results are showed in Table 17. The results indicated that STEM-students with a higher score on level of identification were most likely to have a foreclosure status (exp(b) = 463750.36). All exp(b) were >1, which a assumed that with a higher score on level of identification it would not be likely to have a moratorium status (reference category). In order to better interpret the results of the analysis, also achievement was used as reference category (Table 18). Participants with a higher score on identification were significantly less likely to have a diffusion status (exp(b) = .001) or a moratorium status (exp(b) = 5.26E6) than an achievement status. Same was true for the searching moratorium (exp(b) = .53), although this was not significant. Participants with a level of identification were more likely to have a foreclosure status (exp(b) = 2.58), but again, this finding was not significant (p > .05).

Table 17

Influence of the level of identification on the identity status of STEM-students

								95% Confidence Interval for Exp(B)	
		B	SE	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Achievement	Intercept	-.36.31	9.57	14.40	1	.00			
	Level of identification	12.10	3.21	14.19	1	.00	1799889.92	331.89	97502592.76
Foreclosure	Intercept	-39.77	9.67	16.92	1	.00			
	Level of identification	13.05	3.23	16.33	1	.00	463750.36	827.64	259851343.96
Diffusion	Intercept	-12.32	5.79	4.53	1	.03			
	Level of identification	4.85	2.17	5.00	1	.03	127.61	1.82	8958.10
Searching moratorium	Intercept	-33.51	9.31	12.96	1	.00			
	Level of identification	11.46	3.16	13.18	1	.00	94504.34	194.64	45884118.22

Note. Reference category: Moratorium status.

Table 18

Influence of the level of identification on the identity status of STEM-students

								95% Confidence Interval for Exp(B)	
		B	SE	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Foreclosure	Intercept	-3.46	3.50	.98	1	.32			
	Level of identification	.95	.91	1.08	1	.30	2.58	.43	15.36
Diffusion	Intercept	23.99	7.45	10.37	1	.001			
	Level of identification	-7.25	2.30	9.92	1	.002	.001	7.79E-6	.07
Searching moratorium	Intercept	2.80	3.42	.67	1	.41			
	Level of identification	-.64	.93	.48	1	.49	.53	.09	3.22
Moratorium	Intercept	36.31	9.57	14.40	1	.00			
	Level of identification	-12.10	3.21	14.19	1	.00	5.56E-6	1.03E-8	.003

Note. Reference category: Achievement status.

Relation level of identification and the career choice (RQ 6.2). A logistic regression was performed to ascertain the effects of the level of identification on the likelihood that STEM-students choose for a technical function. Comparing the intercept model and the final model, model fit indices and log likelihood indicated indeed systematic variation (Δ AIC = -.53, Δ BIC = -2.61, Δ -2LL = 1.47), which means that the variation between the level of identification and the career choice was not random. Pearson and deviance statistic test were both not significant, indicating sufficient model fit. Nagelkerke R^2 showed that the model explained only 3.3% of the variance. Analysis of the individual identity status revealed that level of identification did not significantly influenced the career choice of STEM-students, displayed in Table 19. Subsequently, the magnitude and direction of the influence of the level of identification on the career choice was analysed. Results are showed in Table 20. The results indicated that STEM-students with a higher score on level of identification are most likely to choose for a technical function (exp(b) = 1.66), however this influence is not significant (p > .05).

Table 19
Influence of the predictor level of identification on career choice

	Model fitting criteria			Likelihood ratio tests		
Effect	AIC of reduced model	BIC of reduced model	-2 Log likelihood of reduced model	Chi-square	Df	Sig.
Intercept	48.88	50.69	46.88	1.36	1	.243
Level of identification	48.99	51.06	46.99	1.47	1	.226

Table 20
Influence of the level of identification on the career choice of STEM-students

								95% Confidence Interval for Exp(B)	
		B	Std. Error	Wald	Df	Sig.	Exp(B)	Lower Bound	Upper Bound
Technical function	Intercept	-1.72	1.49	1.32	1	.25			
	Level of identification	.508	.427	1.41	1	.23	1.66	.72	3.84

Note. Reference category: Non-technical function

Relation identity status and the career choice (RQ 7). A Chi-square test of independence was calculated comparing the identity status in a technical profession and a non-technical profession (career choice). A non-significant interaction was found, N = 59, $\chi^{(1)}$ = 3.334, p = .504, ϕ = .238. Table 21 shows that the technical function and non-technical function choices were substantially equal for the five identity statuses, except for moratorium. Participants with a moratorium status were more likely to choose a non-technical function (8.5%) than a technical function (1.7%).

Table 21

Relation identity status and future function (N=59)

		Career choice - function		
		Technical	Non-technical	Total
Identity status	Achievement	5 (8.5%)	5 (8.5%)	10 (16.9%)
	Foreclosure	7 (11.9%)	6 (10.2%)	13 (22.0%)
	Diffusion	7 (11.9%)	6 (10.2%)	13 (22.0%)
	Searching moratorium	10 (16.9%)	7 (11.9%)	17 (28.8%)
	Moratorium	1 (1.7%)	5 (8.5%)	6 (10.2%)
	Total	30 (50.8%)	29 (49.2%)	59 (100%)

To investigate the career choice further, a Chi-square test of independence was also calculated comparing the identity status in technical organization and a non-technical organization (See Table 22). Again, a non-significant interaction was found N = 54, $\chi^{(1)}$ = 2.99, p = .56, ϕ = .24. However, differences between technical and non-technical organizations were bigger than the differences for technical functions and non-technical functions.

Table 22

Relation identity status and future organization (N=54)

		Career choice - organization		
		Technical	Non-technical	Total
Identity status	Achievement	7 (13%)	2 (3.7%)	9 (16.7%)
	Foreclosure	10 (18.5%)	2 (3.7%)	12 (22.2%)
	Diffusion	9 (16.7%)	2 (3.7%)	11 (20.4%)
	Searching moratorium	11 (20.4%)	5 (9.3%)	16 (29.6%)
	Moratorium	3 (5.6%)	3 (5.6%)	6 (11.1%)
	Total	40 (74.1%)	14 (25.9%)	54 (100%)

Additional analyses. To discover if a relation between the student level and the career choice can be found, some additional analyses were performed. The preferable function and organization is compared to the student levels University of Applied Sciences (Saxion) and University (University of Twente). A cross tab of the preferable function can be find in Table 23. The results of the Pearson Chi Square showed that there was a significant relation between the student level and function, N = 59, $\chi(1)$ = 7.766, p < .01, ϕ = .363. A remarkable result is that students of the University of Applied Sciences were more likely to choose a technical profession than students from the University of Twente, respectively 30.5% over 20.3%.

A cross tab of the preferable organization can be find in Table 24. The results of the Pearson Chi Square showed that there was a significant relation between the student level and organization, N = 54, $\chi(1)$ = 4.70, p < .05, ϕ = .20. Just like with the function, students from the University of Applied Sciences preferred a technical organization more than students from the University. However, this difference was smaller. Both results showed the great difference between the function and organization. Whereas 50.80% of the participants would choose for a technical function, no less than 74.10% preferred a technical organization.

Table 23

Cross Tabs for student level and function (N=59)

		Student level		
		University of Applied Sciences	University	Total
Function	Technical	30.50%$_{(21.50\%)}$	20.30%$_{(29.30\%)}$	50.80%
	Non-technical	11.90%$_{(20.80\%)}$	37.30%$_{(28.30\%)}$	49.20%
	Total	42.40%	57.60%	100%

Note. Subscripted percentage is expected count.

Table 24

Cross Tabs for student level and organization (N=54)

		Student level		
		University of Applied Sciences	University	Total
Organization	Technical	40.70%$^{(34.26\%)}$	33.30%$^{(39.81)}$	74.10%
	Non-technical	5.60%$^{(12.04\%)}$	20.40%$^{(13.89\%)}$	25.90%
	Total	46.30%	53.70%	100%

Note. Subscripted percentage is expected count.

Conclusion and Discussion

The purpose of the current research was to understand what STEM students' perceptions are about the content of their future professional identity (e.g., engineer) and how this affects their future (career) choices. The research was divided in a qualitative part and a quantitative part. Both parts will be discussed with reference to the research questions. Following on the conclusions corresponding limitations regarding the results will be discussed. Subsequently, the methodological limitations will be considered. The conclusion and discussion will be concluded with some practical implications, based on the present study.

Content of the personal and professional identity. The first two purposes of the study were to describe the content of STEM-students' current personal identity (RQ1) and their perceptions of the future professional identity as engineer (RQ2). In order to answer these research questions, I discuss each dimension of identity separately. For the dimension skills was a clear and coherent description that was in line with prototypical characteristics of engineers like *being practical* and *pragmatic* (Faulkner, 2000). Also this content was for both personal and professional identity substantially equal. For the other dimensions of identity, values, personality and goals more differences in the content across personal and group descriptions were found. The categories described for the personal identity were more focused on social characteristics, and the content of categories described for the professional identity were more work-related. By contrast, for the dimension interests more overlap could be found, but the content was highly varied. Participants indicated that they found it hard to specify interests of an engineer as they considered this as very personal. In other words, it seemed that interests do not define the proto-typical engineer, in contrast to skills.

Career exploration activities. Also, it was investigated what explorative activities STEM-students undertake to discover the professional field (RQ3). Quantitative results showed that STEM-students scored low on exploration activities in the career status questionnaire (Mancini et al 2015),

but when asked about the career exploration activities they would perform in an open question, they mainly mentioned experiences in the real 'working world'. This included for example visiting business fairs, companies and internships. The low score on exploration was also reflected in the average number of activities noted by the participants. Reasons for a low score of exploration will be discussed further in the section about the identity status. Discussions with fellow students was not often mentioned as a career activity. This low number could be explained by the fact that it is not regarded as a concrete career explorative activity and is intertwined with conversations about other topics.
As described earlier, students often called activities related to the real practices to become familiar with the profession. This is in line with results of a previous study of Pierrakos et al. (2009) where they showed that exposure to engineering and meaningful activities led to a greater chance that students persisted in the technical field. To make this more concrete; to raise the number of STEM-students and engineering professionals, it seems valuable to focus on exposure to the practice. So this is not just about providing information about the profession, but talking with the engineering professionals, or get acquainted with the real practice in a technical company for example. On the other hand, it seemed that there are sufficient opportunities to discover the professional field, based on what the participants mentioned. But students did not mentioned things like introspection, career tests or conversations about their own competences. These are requirements that are also very important for developing a professional identity (Hannover & Kessels, 2004).

Overlap between the personal and professional identity. Current research aimed to measure the extent to which STEM-students' current self-perceptions match with their perception of their future profession as engineer (RQ 4), as consistency between the traits of a profession and the self-concept of a student can be seen as crucial factor in forming the professional identity (Ibarra, 1999). As discussed earlier, the content of the personal identity and the professional identity (RQ 1 and RQ 2) differed. Whereas a maximum overlap of 25 was possible, the mean overlap was 6.02, resulting in an overlap of just 24.08%.

This low overlap could be explained by two arguments. First, although STEM-students had a broad knowledge of the professional engineer, still they had quite little words to describe that identity. In fact, the current used methods pushed to participants to give a nuanced description and restrained them from giving a broad description. This may have turned in an improper overlap between the personal and professional identity, and therefore in a negative relation between the overlap score a level of identification. Using the STPM strategy demands from students that they can provide a rich description of both personal and professional identity.

The second reason is more of methodological nature because the method of the current study differed from the method of Hannover and Kessels (2004). Hannover and Kessels (2004) divided their sample over two groups. The first group had to describe four favourite-subject-prototypes, the second group had to describe four least-liked-subject-prototypes. Subsequently, 65 trait adjectives had to be rated according how well they described the prototype, using a 7-point Likert scale. After that, participants were asked to rank the remaining school subjects. Finally participants were asked to describe themselves, using the same 65 trait adjectives and 7-point Likert scale. At two points, both methods greatly differ. First, participants of Hannover and Kessels (2004) described first the prototype and after that, they described their personal identity. In the current study participants first described their personal identity and subsequently the identity of an engineer. Describing first the identity of an engineer could activate students' stereotypes as a base-rate or prime, activating the tendency to appoint these characteristics also for themselves (i.e., self-stereotyping). Second, in the current study participants had to choose a maximum of five cards per category to describe the personal or professional identity. Participants of the study of Hannover and Kessels (2004) did not have to choose, but indicated for all 65 adjectives the extent to which it suited them on a Likert scale. This method offers a more subtle measure with each of the 65 adjectives being part of more or less overlap between the two descriptions. In the current study, for each trait was a dichotomous choice whether overlap existed (yes/no). Concluding, it could be that if using the same method as Hannover and Kessels (2004) more overlap would have been found between the personal and professional identity. Yet, this would not have allowed for a bottom up approach to describe the professional identity of engineers.

The fact that we found so little overlap could not only be attributable to methodological limitations, but also to the fact that in their professional development bachelor students might feel quite uncertain or unclear about their future profession as this profession is still in the far future (more than one or two years ahead for most bachelor students). To this end, lack of overlap might be caused by a lack of self-clarity about one's professional identity. Indeed, research showed that introspection is a difficult process (Vignoles, Schwartz, & Luyckx, 2011) and that only a few people have formed a concrete identity resulting from active exploration during adolescence (Kroger, 2007). This could be a reason for the fact that students do not have a clear self-concept yet, because the development of identity continues over the adulthood (Arnett, 2000) as the professional identity is shaped by experiences and meaningful feedback. Another studies confirmed the continued development of the professional identity. For example, Schein (1978) indicated that life as well as work experiences influence the professional identity by reformulating their priorities and self-understanding. In addition, according to Ibarra (1999) individuals adjust and adapt their professional identity during periods of career transition. Therefore, it could be interesting to perform similar research among professional engineers.

So, investigating professional identities is not only about the new identity of the future profession, also the clarity of the current self-concept is of interest. For future research it seems to be valuable to research the self-concept of STEM-students in addition to the commitment and affirmation with a technical profession. Besides, schools could work with students on their self-concept in order to find their real preferences regarding their future profession.

Overlap and level of identification. After discovering the overlap between the personal and professional identity, the relationship between the overlap score and the level of identification (RQ 5) was investigated. Only a small marginal significant relation between the overlap score and the level of identification was found. Remarkably, this relationship appeared to be a negative relationship. This means that students who showed to have more overlap between the personal identity and the identity of an engineer, identified less with their future profession as engineer. This result is not in line with previous results that suggested that consistency between the personal self and the profession determines the level of identification (Hannover & Kessels, 2004; Ibarra, 1999). This contradiction raised questions. A possible explanation relates to the content of the personal and professional identity that STEM-students described. STEM-students with a more restrictive image of the profession of an engineer, presumably showed greater overlap because they used less variation in the description of the professional identity of an engineer. STEM-students with a more differentiated image of the profession of an engineer probably used more different words to describe the content of a professional identity of an engineer. Therefore, it is likely that these students showed less overlap between the personal and professional identity. To prevent this either the method to gather data should be adapted, for example in line the method of Hannover and Kessels (2004), or before data gathering, participants should work on their self-concept.

Relationship between the Level of Identification and Identity Status and Career Choice. The current research investigated the relationship between the level of identification and the specific identity status of STEM-students and how the level of identification relates to the career choice (RQ 6.1 & RQ 6.2). First identity status will be discussed. Subsequently, a discussion about the career choice will follow.

Identity status. Current research investigated the identity status of the STEM-students. After forming five clusters based on the *k*-means cluster analysis, two researchers independently asses which status belonged to the five clusters. Both had same results, indicating a great inter-rate reliability. With some small differences in the proportions of the processes relative to the clusters of Mancini et al. (2015), current research ran into the same clusters. The main difference with Mancini et al. (2015) is that overall STEM-students tended to be less explorative than psychology students.

Investigating the relation between the level of identification and the identity status (RQ 6.1), it appeared that with a higher level of identification it was less likely to have a moratorium status relative to one of the other four identity statuses, as expected. In contrast, with a higher level of identification, it was more likely to have an achievement status relative to a diffusion status or moratorium status. No differences were found with regard to a foreclosure and searching moratorium status. On the whole can be concluded that there is a division between the identity statuses when it comes to the extent of identification. Based on the results, students with a searching moratorium, foreclosure or achievement status were more likely to have higher level of identification with the future profession than STEM-students with a moratorium or diffusion status. While these effects replicate prior research, it must be noted that conceptual overlap between the items to measure the level of identification and the items of affirmation and commitment existed. Future research should discover concisely the items to measure the level of identification and the identity status to prevent conceptual overlap in the questions, but also using items for two variables.

Career choice. Next to the identity status, current study aimed to investigate the relation between the level of identification and the career choice of STEM-students (RQ 6.2). No significant relation between the level of identification and the choice for a technical function was found. This is not in line with the social identity theory. According to this theory, an individual adopts the identity that characterizes a social category they belong to (Tajfel & Turner, 1979, as cited in Hogg et al., 1995). So, the extent of identification should determine the choice for a technical function or a non-technical function. The fact that this is not reflected in the current research, is again possible due less exposure to the profession of an engineer. Because students could have no right or complete impression of the professional identity of an engineer, the identification with the future profession of an engineer could be an 'empty' concept. By this is meant that the identification has no proper foundation and therefore the choice to persist or stay in the technical field relies not on the level of identification yet. As already described, more exposure and knowledge of the profession could stimulate the level of identification, in a positive or negative way. With these 'baggage' STEM-students will think more concisely about the identification with the profession and subsequently this level of identification will relate more to their career choice.

Relation identity status and career choice. Furthermore, the relation between the several identity statuses and the career choice was analysed (RQ 7). The five identity statuses were compared for both technical or non-technical function and organization. First, the results showed that having a certain identity status did not influenced the choice for a technical or non-technical function. Secondly, also the choice for a technical or non-technical organization was not determined by the identity status. These results were not as expected. As the several identity status differ in the degree of commitment (Mancini et al, 2015), it would be logical to have variation in the choice for a technical or non-technical function and organization. For example, as a moratorium status represents less commitment to the profession of an engineer, it seemed more likely that STEM-students with a moratorium status do not opt for a technical career. Contrary, students with an achievement or foreclosure status should have more commitment to the future profession and therefore more inclined to opt for a technical function or organization. However, possible reasons for this lack of relation could be the same as for the lack of relation between the level of identification and career choice.

Additional analysis. Lastly, exposure to the profession of an engineer seemed to be valuable for creating a professional identity. Therefore the present study additionally tried to link the career choice (both function and organization) to the student level (Applied University students or University students). Results showed a significant relation for both function and organization; students of the University of Applied Sciences were more likely to choose a technical function and organization than students of the University. This relation between the student level and the function is in line with previous research of Möwes (2016).

An explanation for these results could be the fact that students from the University of Applied Sciences are more practically and specifically trained for a certain profession, relative to University students. For example, while bachelor students from Applied Universities do internships at organizations as part of their study program, such internships are not always part of Universities' educational programs. As exposure to engineering is an important factor for choosing a technical profession (Pierrakos et al., 2009), it seems to be a natural consequence that more students from the University of Applied Sciences will choose for a career in the technical field.

Methodological Limitations

There are a number of methodological limitations in the current research. To discuss this in a structured way, first some general points will be discussed. Additionally some practical implications will be discussed.

First it should be mentioned that questions used in the present study were previous used in a study under psychology students (Mancini et al., 2015). Although psychology students and STEM-students are never compared in a study before, some differences in stereotypes exist. For example, psychologists are described as understanding, patient and helpful (Webb & Speer, 1986). Typical words for engineers are intelligent (Hong & Lin-Siegler, 2012), practical (Faulkner, 2000). These differences may be reflected in the ability to describe and reflect on the personal identity. Besides, as psychology students study psychological processes, it can be assumed that psychology students are more familiar with self-reflection and self-evaluation. Already during the pilot version of the questionnaire it appears that the STEM-students were struggling to describe their personality. Therefore it was decided to support the participants with some stimuli (Möwes, 2016). However, as STEM-students are less confronted with self-evaluation, completing the questionnaire could still be a hard job. This is also evident in the time they needed to complete the questionnaire. Were the researchers expected it would take about 15 minutes to complete the questionnaire, most participants needed 30 minutes, indicating it takes effort to think about themselves and express this.

While describing the personal identity and the identity of an engineer, participants were under supervision of the researcher. This in order to bring participants in a reflective mode to think about themselves. During the pilot-version it appeared that participants found it hard to summon a self-description. The researcher could helped them by asking questions in order to stimulate the reflective modus. This direct presence of the researcher and the one-to-one situation could have influenced the answers. For example, participants could be tended to choose less negative characteristics to describe themselves or their future profession. Elaborating on negative characteristics, these are less chosen by the participants and could have influenced the valence of the categories. This can be named as a social desirability bias, which implies that people are tended to speak positive about themselves instead of negative (De Jong, Pieters, & Fox, 2010). So, in case of no or less negative characteristics for the category personality, the percentage of used cards to describe the identity, and thus the relative breadth of the description should be greater, because participant did not use cards because of the negativity. Nevertheless, stimulating the self-reflection of the participants was considered as more important the potential tendency to social desirability. In case of reducing this chance, future researchers could think about deleting negative characteristics.

With regard to the career choice, it must to be said that the judgement whether a function or organization was technical or not, was made by only one researcher. This could have influenced the reliability of the results on the career choice of STEM-students. Thus, the results about the preferred function and organization have to be interpreted carefully. It is recommendable for further research to have more researchers to categorize the answers of the participants with sufficient inter-rate reliability to increase the reliability of the results.

An important quality of the present study was the mixed-method set up, and the fact that both qualitative and quantitative methods were used to understand professional identity development. Using a bottom-up approach and supporting the participants by completing the questionnaire was a time consuming process, thus the sample consisted of 60 participants. Yet, this is a small sample for the statistical analyses required for this research model, and it could have influenced the results of the study. Considering the small anticipated effect size (relative small differences between the several identity statuses), the research could have advantage of a larger sample. In addition, although the population consisted of STEM-students, the sample had little homogeneity as the STEM-students followed different studies, had different gender and student level. Finally, type I error could have occurred when participants took a lot of effort and no longer appropriate the questionnaire. In order to draw stronger conclusions, a greater sample is recommendable.

Practical Implications

The results of the current study could be used to improve the inflow of professional engineers. To begin with a practical implication for Universities of Applied Sciences and Universities. The Dutch government has several initiatives to increase the number of children choosing a technical profile (Ministerie van Economische Zaken and Platform Bèta Techniek, 2015). Mostly these initiatives are focused on primary and secondary education. It would be valuable to extend these initiatives to Universities of Applied Sciences and Universities. Yet, students did already called explorative activities to discover the professional field. This entailed for example internships or visiting business fairs. Naturally, this could still be encouraged, as exposure to the practice is an important factor in defining the professional identity (Pierrakos et al., 2009). But, the participants did not called reflective activities. Nonetheless, this is important to concretize their self-concept, as a clear self-concept helps students to find what fits to their own personality identity (Hannover & Kessels, 2004). So, educational institutions could help students to work on their self-concept and reflecting on the career options.

Next to educational institutions, also technical companies could anticipate to the need for exposure to the profession of engineers. Companies could establish contacts with educational institutions in order to provide the link to the practice of engineering.

Lastly, a gap between the number of STEM-students and the number of graduated STEM-students that opt for a career inside the technical field is indicated (Volkerink et al., 2013). The identity status of STEM-students could be used to improve the academic experiences of student and the supply of study activities. In case of having a diffusion status, it could be said that students are not in the right place. Educational institutions could use this information to reformulate the description of the study. Besides, the Universities (of Applied Sciences) could help students to find out what their preferences and goals regarding a study and professional career is and find an appropriate study program. This will get more students in the right place and decrease the outflow of graduated STEM-students to a non-technical career (Rijksoverheid, 2013).

Concluding

Concluding, despite the rising demand for highly educated STEM-professionals, many STEM-students do not opt for a technical function. Reasons for this are mostly unclear. As a matter of fact, the present study provides even more questions instead of answers and offers scopes for follow-up studies. The current study investigated the content of the personal and professional identity of an engineer and demonstrated that indeed, STEM-students perceive relatively little overlap in their current self-concept and their professional identity as engineer. By linking the overlap score to the level of identification, it appeared that students who showed a greater overlap between the personal identity and professional identity, less identified with the future profession as engineer. This finding is not in line with previous research that did found a positive relation between the overlap in the personal and professional identity and the level of identification. Additionally, previous research showed that exploration in the professional field is of interest for developing a professional identity. Although the STEM-students mentioned some explorative career activities, a general low score on exploration was found. This could suggest that exploration could stimulate the professional identity, but in addition, reflection on this exploration is of interest. All these results refer to the self-concept of STEM-students. To know what STEM-students do want to become, they have to know who they are.

The results of this current study contributed to the exploration of the professional identity of STEM-students and their future profession and moves one step further to closing the gap between the amount of STEM-students and the full-filled technical vacancies. Insight in this gap requires insight in the personal and professional identity of STEM-students.

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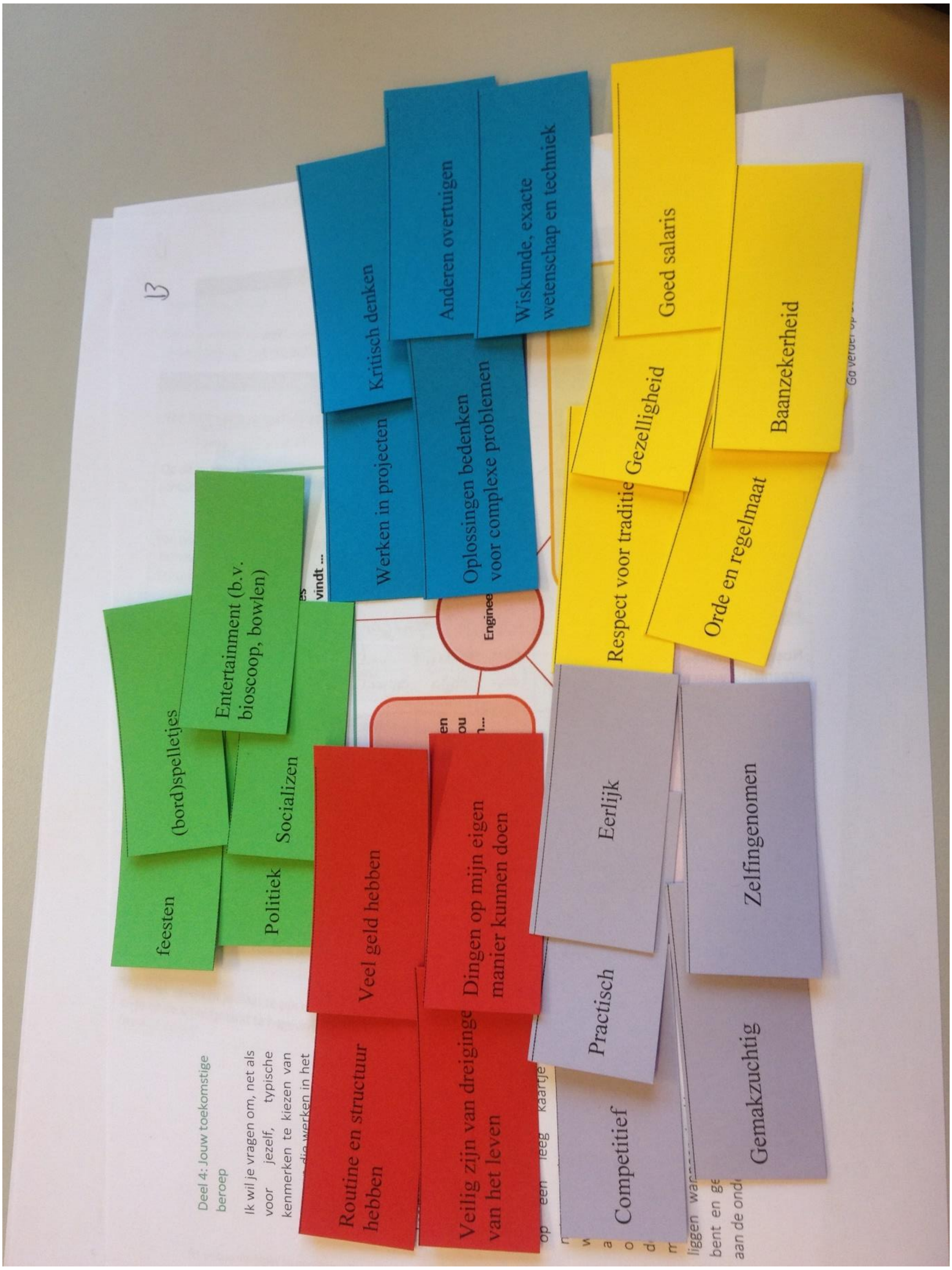
Appendix 1 – Example of Card-sorting Activity



Appendix 2 - Characteristics that were not Chosen to Describe the Professional Identity

	Professional		Personal	
	Characteristic	% not used	Characteristic	% not used
Skills	Informal conversation Chairing meetings Evaluating myself Negotiation	9.52%	Using multimedia to communicate	2.56%
Values	Hygiene Forgiving Good health Honouring parents and elders Appreciating history, world affairs and cultures A spiritual life	13.64%	Excitement Influence Authority Preserving my public image Taking responsibility for ethical concerns Role models	13.64%
Personality	Devious Silent Spontaneous Irritable Friendly Hot-tempered Irresponsible Philosophical Superficial Obedient Artistic Inconsiderate	27.27%	Self-centred Devious Hot-tempered Irresponsible Superficial Artistic	13.64%
Goals	Live a spiritual life Have children Eat healthy	10.71%	Be attractive Avoid hard work Lead a predictable life Have an easy life	14.29%
Interests	Dancing Writing Animals Shopping Gardening	17.86%	Writing Shopping	7.14%