Ute Hillmer

Technology Acceptance in Mechatronics

The Influence of Identity
on Technology Acceptance

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Acknowledgements

This dissertation is the result of five years of research and twenty years of practical experience. It was a journey through areas of existing, often untypical knowledge domains in order to investigate and interpret patterns of experience, gathered through many years as a practitioner. During this journey, I expanded my understanding and consciousness considerably regarding the variety of perspectives available. As a result, there appears to be a more open, new understanding, not only in the context of technology adoption, but in understanding human behaviour.

I would like to thank numerous 'travelling companions' from research and practice. In numerous discussions, they helped me stay in touch with reality. They opened doors, and gave stimulating and helpful suggestions: Henry Blum, Prof. Dr. Kazem Chaharbaghi, Dr. Sandy Cripps, Jürgen Häberle, Reinhard Hamburger, Dr. Marco Litto, Prof. Dr. Paul Privateer, Dr. Thomas Roser, Volker Schiek. Special thanks also to the designers and managers, who participated in this research. I am grateful that they supported this study by giving me access to their thoughts and feelings.

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<div align="right">Dr. Ute Hillmer</div>

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List of Abbreviations

AR	Action Research
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAPS	Cognitive-Affective Processing System (formerly: Cognitive-Affective Personality System)
CSE	Computer Self Efficacy
DOI	Diffusion of Innovation
EE	Electrical Engineering
GT	Grounded Theory
ME	Mechanical Engineering
P-CMM	People Capability Maturing Model (P-CMM
SCT	Social Cognition Theory
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasones Action
UTAUT	User Acceptance of Information Technology

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Part I: Foundation

*We shall not crease from exploration
and the end of all our exploring
will be to arrive where we started
and know the place for the first time.*

Eliot, Four Quartets

1. Abstract

Continuous developments in the fields of knowledge and technology compel rapidly changing business environments, thus, organisations are forced to change their way of doing business and adopt new technology at an increasingly faster rate. This results in a high rate of ongoing technological change in the working environment, with the effect of an increased interest in understanding user technology acceptance. Despite a large number of theories, the success of a technology amongst its users remains hard to understand and ranges from enthusiastic endorsement, to intermediate variations, all the way to open rejection.

The central aim of this research study was to develop a greater understanding of the relationship between technology acceptance behaviour and social and/or personal influence in a working environment. The study attempted to further understand how social and personal influences affect an individual's subjective interpretation of a situation in which technology changes significantly. This was achieved by increasing an understanding of the subjective meaning users attain in a situation of technological change that leads to their particular technology acceptance behaviour.

In order to apply a multi- and cross-disciplinary consciousness about the spectrum of possible relationships, the individual, societal and organisational knowledge domains were critically explored. A model of social and individual influences developed, that was continuously modified in order to take into account new understandings from theory and the researcher's personal experience. This pragmatic bricolage – grounded theory based frame analysis eventually led to a merged understanding of symbolic interactionism's identity theory in combination with the self as a dynamically networked cognitive-affective meaning system. Within this combination, society's and individualistic influences become observable through an individual's various social identities, along with his or her personal-identity that form an individually unique combination, dependent on the situation.

Based on this theoretical concept, grounded theory developed data from twenty-two cases of mechatronics machine designers in seven different companies in the

mechatronics machinery industry. The understanding was validated and verified, that a designer's sum of active, central identities within the working context are a key to his or her technology acceptance behaviour. Further segmenting individuals by their more specific identity content offers more detailed insight into behaviour. Technology adoption behaviour can be grasped and assessed, when identities and the related factors that stabilize or destabilize these identities are understood. Comparing them to the opportunity- and thread-potential of the considered new technology, offers understanding for interpretations and behavioural motivations. This potentially offers particularly revealing insight when contrary identities emerge in one person.

In sum, one can conclude that individuals accept technology more easily, if the technology replicates their social values, and if the technology implementation considers these social values.

2. Introduction

2.1 The nature of the problem

Organizational investments in computer aided information and communication technologies have expanded dramatically in most industries of the western business world over the last 50 years. The most central reasons for these investments in technological change are improved productivity; enhanced efficiency or quality; reduction of problems, mistakes, or danger; enlarged span of information, knowledge or control; and enhanced communication or prestige (Crespi et al. 2006; German Statistisches Bundesamt 2007).

However, simply purchasing technology is not enough. In order to obtain an anticipated effect, technology must be used "appropriately" (Agarwal and Prasad 1997, p.15). Such appropriate use is called 'technology adoption' throughout the study. It is contrasted with 'technology acceptance behaviours' used to express the variety of behaviour from endorsing a new technology eagerly through fast or slow conformity with organisational decisions to hidden or open rejection. This breath of behaviour is often inter-situational and even inter-personal. It has the effect that many technology products do not fail in convincing management during the sales process; they are thwarted during test installations or in the rollout phase. Unpredictable and confusing acceptance behaviour is problematic for companies investing in technology, because they allocate money, time and effort from other areas of their business. Unpredictable behaviour is problematic for technology vendors, because they gain margin and reputation from fast and widespread technology diffusion. And it is problematic for projected users that are usually challenged with an increased investment of time and effort to get efficient with the new technology. Thus new technology implementation is often considered a stressful project for all involved parties. Increased understanding of the relationships and mechanisms involved in technology adoption may reduce the effort, time and stress involved in new technology implementation for all.

A growing variety of theories and models address the issue, however, the available spectrum is not satisfying. After 16 years of practical experience with technology diffusion, acceptance behaviour has become increasingly difficult to understand, and the literature in this area is not sufficient to answer the observed inter-situational and inter-personal behavioural variability. What was difficult to understand can be summed up in two statements:

- There seems to be a limited relationship between a products' openly stated, rationally verified features and benefits and its success in the marketplace.
- Many promising, efficiency-enhancing technologies fail at the user level, not at the management level.

2.2 Research objectives

This research study attempts to achieve greater understanding of the relationship between the spectrum of technology acceptance behaviour in a working context and social and personal influences. The objectives arising from this endeavour include:

- To address the knowledge gap between existing technology acceptance models and practitioners reality.
- To give a comprehensive overview on existing technology acceptance models and to critically analyse their limitations.
- To systematically investigate individual behaviour and influences on behaviour.
- To systematically investigate the means of how society and social structures bear influence on individual behaviour.
- To systematically investigate the means of how organisations and their inherent structures bear influence on individual behaviour.
- To combine an understanding from the individual, societal and organisational perspectives to a multi- and cross-disciplinary understanding of an individual's subjective interpretation of a situation of technological change in the working context.

Through an ongoing and iterative research process with several cycles of increased understanding, this led to the consequent aims:

- To test, verify and validate the influence of an individual's meaning and subjective reality on technology acceptance behaviour.
- To test, verify and validate the influence of individuals' various social identities and their personal identity at work on their technology acceptance behaviour.
- To test, verify and validate the influence of embeddeness and networks on technology acceptance behaviour.

2.3 Scope

This study is a multi- and cross-disciplinary investigation of a business problem. Figure 1 illustrates the multi-disciplinary research scope.

Individual perspectives usually found in psychology, more precisely in personality and social psychology, increase the understanding of the complexity of human behaviour. This includes the origin of subjective meaning and a subjective reality, the components of the self and its identities. Societal and organisational viewpoints show the impact of this complexity in social relationship to society as a whole, and the organisational context in particular. A social perspective unveils culturally derived systems of values, beliefs and meanings and it investigates what impact the 21st century's 'information society' has on the individual and his or her perception of technology. The affect that these social conditions have on the choice of

behaviour within the spectrum of technology adoption behaviour is revealed through a narrative of social realities. An organisational perspective allowed for further, more business context specific investigations of social structures, such as organisational, disciplinary or professional cultures.
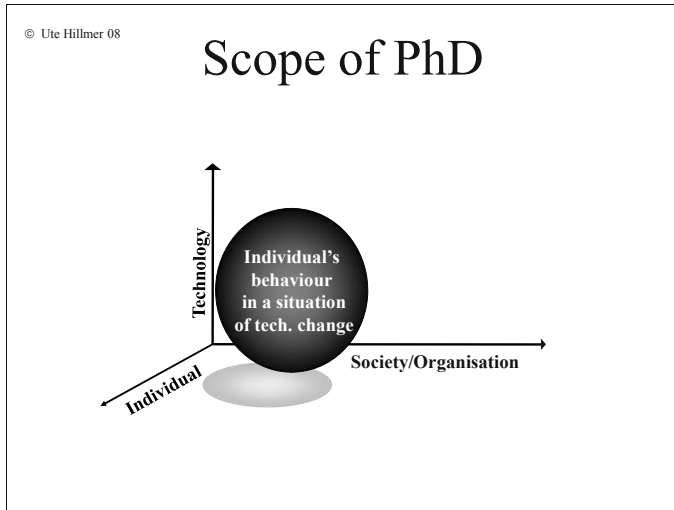
Figure 1: The multi-disciplinary research scope.

2.4 Contribution to knowledge

Contemporary business science usually assumes a business centric, "positivist epistemology" (Johnson and Duberley 2000, p.167), and most existing theories of technology adoption follow that logic. Furthermore, most technology acceptance models have been developed with a certain business goal in mind, using one of many possible perspectives and focusing on understanding an isolated aspect. The models provide a mechanistic, business centric logic, with partial and limited representations. This leads to a mismatch between the complexity of reality and the usually clear-cut models that were found to be relevant but limited. Technology acceptance models need to embrace a more holistic perspective, taking account of the user and his viewpoint. If technology acceptance is to be better understood and theories are to be more meaningful in practice, the user and his or her subjective understanding of the situation ought to be considered.

This study addresses this gap by exploring the influence of an individual's subjective understanding in a situation of technological change, an area that has not been investigated thus far. This alternative approach applies multi- and cross-disciplinary knowledge, which might reveal new insight into technology acceptance behaviour. It may contribute to the spectrum of existing knowledge on

technology adoption, by closing the gap between social structures, social and individual reality with its inherent meaning and its influence on technology acceptance behaviour. This research includes a chance to advance knowledge and understanding, where existing discourses and knowledge are limited in their answers.

Furthermore, this research study applies an untypical methodology for studies in business science. The research is emergent and it applies new learning to the consequent research steps. Such a dynamic methodological approach ignores manifested research approaches and tries uncharted paths. While it is a risky and atypical undertaking in business science, it holds the chance to overcome unrecognised research bias, thereby advancing knowledge.

2.5 Methodology

This research develops a methodology of 'bricolage-grounded theory research', which builds on grounded theory, combined with the pragmatic approach of action-research, directed towards the research and the consequent steps of inquiry, while it does not utilise aspects of action-research that change the immediate business situation. Furthermore, it extends the methodology of grounded theory to include "bricolage" (Lèvi-Strauss; cited in Turkle 1995, p.51). In this combination, it addresses the following methodological issues:

- Identification of the issues to be examined
- Literature review
- Development of questionnaire
- Semi-structured interviews that function as a primary data collecting process
- Analysis of the questionnaire and interviews in order to draw out results/conclusions
- Discussion of findings.

Identification of the issues to be examined
This work departs from the theory based, rational construction method used in scientific work. An inductive and emergent process is used to reveal what questions should be addressed.

Literature review
Derived from the dynamic and investigative methodological approach, a unique bricolage-action-research process permits the literature review to remain flexible and open so that new knowledge can be derived from old and new theory and practice.

Development of questionnaire
The questionnaire evolved from previous work of this kind enhanced by knowledge derived from the action-research process. It collects information about each

individual's interpretation and reflections on their response to technological change; revealing differing approaches to technology acceptance behaviour.

Semi-structured interviews that function as a primary data collecting process
In-depth interviews are the main source for data collection. The semi-structured process allows flexibility and openness, which are relevant because the researched field is an area of uncertainty, instability, uniqueness and conflict. At the same time it offers enough structure to remain relevant.

Analysis of the questionnaire and interviews in order to draw out results/conclusions
Grounded theory is the primary data analysis method. This method permits the researcher to borrow intellectual traditions and insights from various disciplines to inform new knowledge. Furthermore, this methodology can operate unconstrained from existing knowledge thus helping to overcome unrecognised research bias.

Discussion of findings.
A final discussion of findings dynamically reframes the research problem with new insights.

2.6 Study layout

This study is atypical in its structure because it is emergent. What is traditionally presented as one block of theoretical background is split into two parts: a review of existing technology acceptance models (Part I, Chapter 3), that are understood to present a limited understanding of the problem, and a test of anecdotal evidence (Part III, Chapter 5,6,7). In total, the study is comprised of four parts: Part I: foundation; Part II: methodology; Part III: literature review as frame analysis; Part IV: findings, as illustrated in Figure 2.

In Part I, the foundation is set for this work. An abstract summarises the research, Chapter 2 introduces the topic, Chapter 3 discovers the limited perspectives of existing technology acceptance models and illustrates the research gap, which may be completed trough the results of this study.

Part II covers the research methodology and the motivation to use an atypical format of action research. Chapter 4 offers insight into the frame analysis based on the literature review, as well as on the grounded theory based empirical research. The value of the chosen methodology for this study is also outlined in this chapter.

Part III is comprised of a multi-disciplinary bricolage of existing theoretical knowledge that challenges the consciousness of the researcher, applying a frame analysis in the form of a dynamic literature review. Chapter 5 investigates existing knowledge from a perspective that centres on the individual. This draws from various fields of psychology, mostly from symbolic interactionism and its meaning systems approach in social psychology, but also personality psychology and behavioural sociology. Chapter 6 focuses on the societal perspective, and

investigates the different social realities through the century, different social structures that influence behaviour as well as various mechanisms through which society exercises influence. Chapter 7 further investigates social structures that are particular to organisations. Chapter 8 connects the individual, societal, and organisational perspective to one multi- and cross-disciplinary bricolage of new consciousness, which builds the foundation for the consequent field investigation.

Part IV introduces the field research results, which are analysed in Chapter 9. Chapter 10 discusses the findings, offers implications for theory and practice, and discussed the limitations of this research and opportunities for future research. Chapter 11 concludes by summarising the main findings, followed by recommendations.
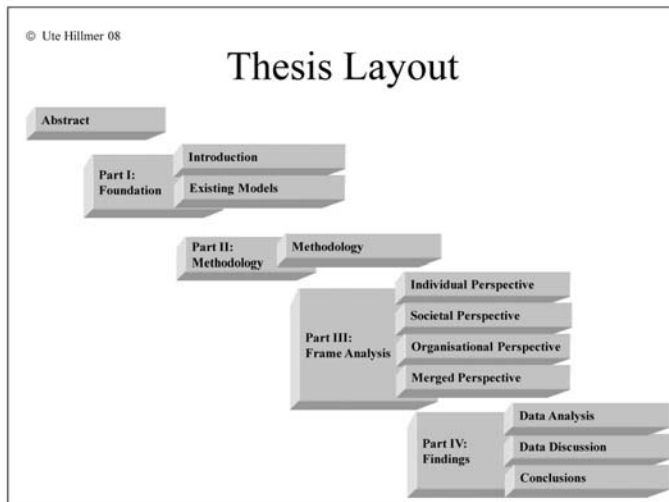
Figure 2: Study layout

3. Existing Theories Considering Technology Adoption

3.1 Introduction

This chapter introduces various models used today in a practical or in an academic setting in order to predict the use and spread of technology. They are analysed and compared, in order to illustrate the research gap that this dissertation intends to fill.

The successful diffusion of technology, especially information and communication technology is considered strategically important in a business context (German Statistisches Bundesamt 2004, p.7). Therefore, the field of theories and models that investigates successful technology diffusion is broad and can be categorised in various ways. A categorisation based on the goal and focus of each theory is listed in Table 1.

Table 1: Common technology adoption theories, grouped by purpose

Diffusion Theories	User Acceptance Theories	Decision Making Th. (incl. Problem Solving Theories)	Personality Theories	Organisation Structure Theories
Innovation Diffusion Theory IDT also called Diffusion of Innovation Theory DOI (Rogers 1962) Technology Lifecycle Theory (Rogers 1962; Moore1995) **Focus on technology, on the environment and on the using organisation**	Theory of Reasoned Action TRA (Ajzen and Fishbein 1973, 1975) Theory of Planned Behaviour TPB (Ajzen 1991) Technology Acceptance Model TAM 1; TAM 2 (Davis 1989) Motivational Model (Vallerand 1997) User Acceptance of Information Technology UTAUT (Vankatesh et al. 2003) **Focus on the rational employee interest**	Rational Choice Theory/ Game Theory Decision Making under Uncertainty Risk Management Change Management Media Richness Theory (Daft and Lengel 1984) **Focus on the rational organisational/man agement interest**	Technology Lifecycle Theory (Rogers 1962; Moore 1995) Non-technology related approaches are : Social Cognitive Theories SCT (Compeau and Higgins 1995) **Focus on the individual cognitive interest**	Disruptive Technology Theory (Bower and Christensen 1995) Creative Destruction Theory (Schumpeter 1912, 1942) **Focus on the strategic organisational interest**

While the drive for deeper understanding in various areas of technology acceptance dominate academic research, the hope for more predictability of the success of a technology, its successful implementation and diffusion dominates the practical field: the technology developing industry seeks indicators that tell them what

technology to develop and with which attributes. The technology-consuming organisation seeks information that helps develop a successful change management process for technology implementation and the technology user might seek a process to better understand which technology enhancement will best aid his or her working needs and working stile.

3.2 Existing technology adoption models

This paragraph reviews a selection of existing models in order to compare and differentiate them from the proceedings chosen in this study. Some of the models are widely used among practitioners, such as 'the diffusion of innovation' DOI, 'the technology lifecycle theory' and 'the rational choice theory'. Others are more commonly used in the academic world, such as 'the Theory of Reasoned Action' TRA, 'the Theory of Planned Behaviour' TPB, 'the Technology Acceptance Models' TAM, and the unified model UTAUT.

3.2.1 Diffusion theories

"Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system." (Rogers 1995, p.5), thus diffusion of innovation is the theory how, why, and at what rate new ideas and technologies spread through a defined community.

3.2.1.1 Diffusion of innovation (DOI)

Most famous and most widely used is the diffusion of innovations theory from Rogers (1962) (Surry 1997; approx. p.2) which has become the basis for widely used practitioner models (see e.g. Moore 1995, 1999). While he discusses a theory for innovations, which can be an idea, a practice, or an object, most of his examples are technological innovations (Rogers 1995, p.35). According to this theory, many determinants influence the diffusion of an innovation. In order to capture this complexity, Rogers breaks the process down into a series of theories that interact to influence the diffusion process. The innovation (ibid. p.11), the communication channels or how information about the innovation is communicated (ibid. p.17), the innovation decision processes and the innovativeness of an individual (ibid. p.20), as well as the nature of the social system into which the innovation is being introduced (ibid. pp.23-5). The speed of diffusion of an innovation depends primarily on the attributes of the technology, a good diffusion network that starts by word-of-mouth, and continues by imitation, supported by change agents and stakeholders.

Innovation-decision process

The innovation-decision process (ibid., p.161) is the process through which an individual or a decision-making-unit DMU of an organization passes through stages from first knowledge of an innovation, to forming an attitude towards the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (ibid.). Who in an organizational structure makes

the innovation decision at what time and for who is an important consideration (ibid. pp.372, 392).

Rate of adoption

Variables that determine the rate of adoption include perceived attributes of an innovation, the type of innovation decision, communication channels, and the nature of the social system and change agents' promotion efforts.

Perceived attributes of an innovation

Perceived attributes of an innovation (ibid., pp.204-7) states that potential adopters judge an innovation based on their perceptions in regard to five attributes of the innovation, which are: relative advantage; compatibility, complexity, trialability, and observability. This theory says that an innovation will diffuse faster if one or more of the following factors apply: When the adopter perceives a relative advantage over other technologies or over not using the new technology; when the cognitive or sensitive concept of the innovation is compatible with existing practices and values; when it is not overly complex; when it can be tried on a risk-free basis; when its results can be observed, ideally prior to implementation.

The nature of the social system

This aspect includes social norms and the diffusion networks, which represent the degree of network interconnectedness. Social systems are defined as "a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal" (ibid. p.23), and social norms are seen as established behavioural patterns for the members of a social system. Thus, they define a range of tolerable behaviour and they serve as a guide and standard for behaviour (ibid. p.26). Opinion leadership is addressed and the quality of network links is analyzed. Another aspect addresses the critical mass in interactive innovations such as Internet telephoning. While Rogers (ibid. pp.25-30) describes important elements of the social system, he does not offer a comprehensive theory of its function. The overall structure is his concern: the structures of diffusion networks, the availability of opinion leaders and network links that are loose and at the same time extensive.

According to his theory, innovations are diffused over time in a pattern that resembles an S-shaped curve. An innovation starts with a slow, gradual growth before experiencing a period of relatively dramatic and rapid growth. This will then gradually stabilize and eventually decline (Surry 1997, approx. p.3) as shown in Figure 3.
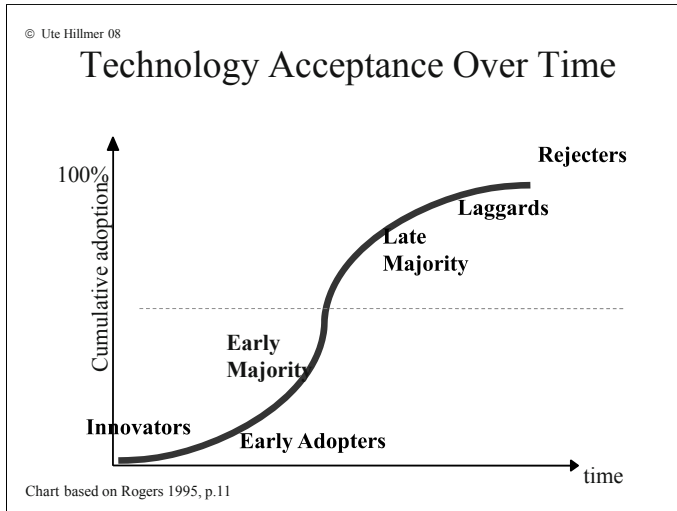
Figure 3: Rogers' S-shape curve of technology diffusion.

Individual Innovativeness or the technology adoption lifecycle
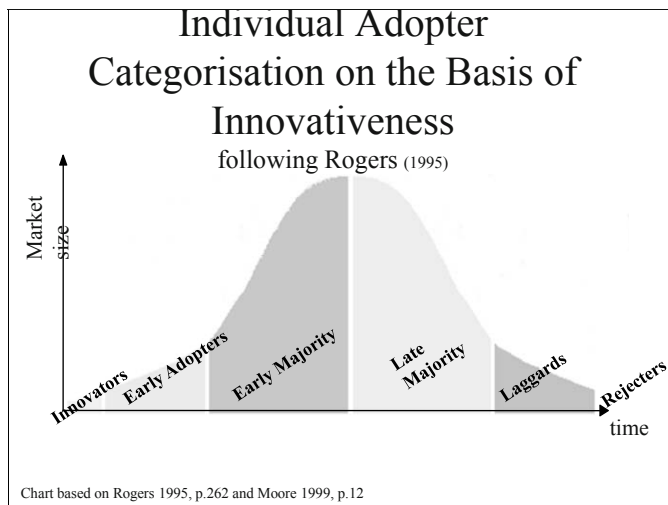
Figure 4: Rogers' innovation adoption cycle with typical adopters.

"The individuals in a social system do not adopt an innovation at the same time. Rather, they adopt in an over-time sequence" (Rogers 1995, p.252), therefore they

can be classified into adopter categories dependent on when they first begin to use an innovation.

Innovativeness indicates overt behavioural change, the degree to which the individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system. According to the model, individual and organisational innovativeness is roughly distributed along a classic normal distribution curve or bell curve over time. The curve starts with the innovators that are earliest to jump on a new technology, followed by early adopters, followed by an early majority, a late majority and at the end come the laggards (ibid., p.262). This means that statistically, a random sample of any given market or population must contain 2.5% innovators, 13.5% early adopters, 33.4% early majority, 33.4% late majority, and 16.0% laggards. Figure 4 describes this standardised bell curve and its typical adopters. These five categories are ideal types of individuals, with attributes Rogers describes in more detail (ibid., pp.263-5).

Discussion of DOI
Rogers offers a complex but unified theory of diffusion that addresses many different aspects in a technology acceptance process. Even though his theory was developed years ago, his theories remain among those with the highest practical use. The IT industry in the US considers Rogers' work as an excellent tool to explain many different phenomena (Byers 2006). This might be because he does not try to find highly generalised and simplified explanations for complex matters. Instead, he separates a complex situation into many smaller units, which means that his theory can be dealt with using subsets of the theory. His theory offers something of value to the economist who is interested in growth, and the organisational researcher who is interested in change and structure. It is also valuable to social psychologists, who try to understand sources and causes of human behaviour and change, and to sociologists and anthropologists who share an academic interest in social change. Another valuable use of the model is in sales and marketing communications that aim to reduce uncertainty (ibid. p.98) among potential buyers and users.

However, multiple shortcomings are embedded in the theory. First, Rogers' theory assumes the "innovativeness" of an individual to be static. An individual has a certain degree of innovativeness, which indicates at what point in time the individual will adopt a technology in relation to other individuals. Practical evidence argues against this point: e.g., somebody who is keen on trying out the latest database technology might be very reluctant in using new communication technology. Someone who is eager to get new hardware at one point in time might be very reluctant to change next time. Second, Rogers' measures of relative advantage, complexity and compatibility are subjective measures, and thus they are likely to vary between individuals.

3.2.1.2 Technology Implementation Process Theory

Leonard-Barton (1983; 1988) focuses her work on the information and communication flow during and after the decision making process. She widens the attributes of influence and the role of diffusion intermediaries, pointing out that users are not necessarily the choosers (1983, p. 2). The theory also explores the role of expertise and specialised knowledge, and how such knowledge-holders become intermediaries in a diffusion process. According to Leonard-Barton, a technology is negatively correlated to the perceived risk associated with the technology (pp.12-15). She argues that attributes such as advantages over previous practice, cost-efficiency, perceived benefit are directly related to diffusion (p.15), while required skills are not correlated to diffusion (p.12).

Discussion

The contribution of Leonard-Barton's work is the detail she revealed between the relevant attributes in the information and communication process. She thus offers explanations how some contexts are more beneficial to diffusion than others (e.g. the presence or absence of intermediaries. Additionally, she explores the roles and the limitations of opinion leaders. Her theory extension focuses on the technology implementation process and adds depth to particular aspects of Rogers' diffusion theory.

3.2.1.3 Technology Lifecycle Theory

The Technology Lifecycle Theory (Moore 1995, 1999) is a practitioner model that was developed in the early 1990's in the "Silicon Valley" at Regis McKenna, the computer industries' foremost public relations and investor relations agency at the time. The theory focuses on the specifics of marketing high tech products and it is still called "the bible for entrepreneurial marketing" (Byers, 2006), 15 years after it was first published

The theory is a derivative of Rogers' adopter categorisation based on innovativeness, but in contrast to Roger's theory, it includes a gap in the bell curve between early adopters and the early majority as illustrated in Figure 5. This "chasm" (Moore 1991) applies to disruptive or discontinuous technologies that are not in harmony with existing processes, values, understandings and that thus are subject to a variety of different perceptions and interpretations. While usually technologies diffuse along the curve, early adopters and the early majority have a very different value set and different expectations (Moore 1999, p.17). Niche marketing is his strategy to overcome the communication gap between the two different groups of individuals (ibid. p.65-106). Technology attributes must develop to fit the needs of its adopters and eventually become "a whole product" (p.113) with features such as 24 hour support and a network of partners, offering services and products to compliment the core product.

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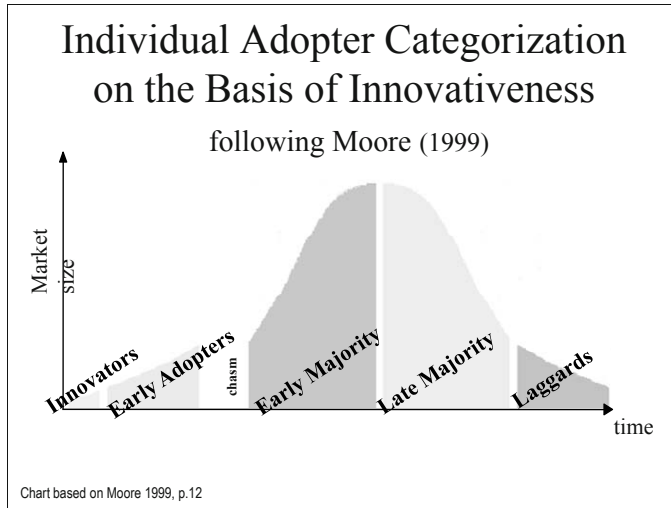
Figure 5: Technology adoption lifecycle with chasm

Another model that Moore adopted from Rogers is the s-shaped cumulated diffusion over time. The theory, called "inside the tornado" (Moore 1995), describes the continuous product life cycle and its consequences for the technology inventing organisation and its partners.

Discussion

Moore's technology lifecycle theory for disruptive innovations has and still is being used extensively by US based practitioners. While he describes many phenomena of the market extremely well, he too assumes that "innovativeness" is a static attribute and once an individual has been categorised, this category fits for all disruptive technologies.

While Rogers describes other elements that influence the rate of adoption and that interact in the diffusion process, Moore ignores social networks and perceived technological attributes to some degree. Never the less, this model is widely used in the high-tech innovation sector (Byers, 2006).

3.2.2 Decision making theories

Decision-making theories are originally an area of discrete mathematics, concerned with finding the best decision to take, based on the objective and the decision criteria. A large number technology buying decisions are based on this technique (e.g. Goa, Sirgy and Bird 2003). A typical sequence in decision making theories is first to understand the problem and set goals, second to consider a variety of solution alternatives and courses of action, and third to collect data and assess probable future outcomes of each and last weight the pro and cons in order to

decide which best fits the goals. One of the most common theories is the rational choice theory, that assumes an ideal decision maker is one who is fully informed, able to compute with perfect accuracy, and fully rational.

3.2.2.1 Rational choice theories

Rational choice is based on the assumption that rational individuals anticipate the outcomes of alternative courses of action and consciously calculate what is most beneficial for their self-interest (Scott 2000, p.127). This understanding significantly gained momentum with the break of modernity and it is primarily based on the assumption that individuals and organisations are motivated by money and by the possibility of making a profit. Particularly in economics, rational choice constructs with formal, predictive models are most influential (ibid., p.126).

Expected outcomes in terms of the likely benefits vs. costs or other disadvantages usually drive technology implementation decisions in organisational settings. Information and its weighting is used as a form of risk reduction; the most influential behavioural support within organisational science (Kramer 1999, p.572).

Any rational choice is based on an explicit, internally consistent value system (Schelling 1960; cited in ibid., p.572) that assumes a profit and benefit maximising individual (Scott 2000, p.126). This point is essential, especially in group decisions, where one explicit, internally consistent value system is assumed to function for all members involved.

3.2.2.2 Decision making under uncertainty

Risk management strategies and decision under uncertainty theories for new technology implementations function along a similar notion (e.g. Gao, Sirgy and Bird, 2003; Hunter et al. 2001; MacDonald and Smith 2003; Sniezek, 2004). They often regard institutional or personal trust between the various actors as a confidence enhancing and risk reduction component. However, once again, such theories only function when they are embedded in one common value system for all actors.

3.2.2.3 Media richness theory

Rational choice theory has led to a few specific branches that address the issue of technology adoption in particular. One is the media richness theory (Daft and Lengel, 1986), a theory that addresses the role of information processing within organisations to reduce uncertainty for organisational actors. It offers structural mechanisms used for information gathering and has a lot in common with Rogers' role of communication channels (1995, pp.194-7).

3.2.2.4 Change management theories

Change management theories are another large field in management science that are deployed for technological change projects. Change management in its common meaning is a structured approach to induce change in individuals, teams, organizations and societies in order to enable the transition from a current state to a

desired future state (Wikipedia, 16.3.08). The theories require first that the logic of the strategy for change is right, in order to use it as a mechanism for change. All required resources are put into place, and all required elements of change are timed and sequenced. Control mechanism and feedback systems allow refinement of the strategy when necessary.

3.2.2.5 Discussion of decision making theories

Critics usually point out that the described rational forms of decision-making and change management can be described as "an iceberg with a small part above the surface of the water and the main part below the surface" (DeWitt and Meyer 1991, p.215). The visual tip represents the rational and factual dimension, but the interpersonal, behavioural, normative, cultural and power dimensions are ignored (ibid.).

Decision-making theories are based on the notion that thinking precedes organisational action (Johnson and Scholes 2002, p.577), which is often criticised as an overstatement of decision makers' cognitive capacity (March 1994; cited in Kramer 1999, p.573), where any emotional or societal influences on decisions are denied. Some even argue that an organizational decision can never be rational, because of a social influence through goal adoption (Castelfranchi and Falcone, 2001). Decision making theories usually assume one shared understanding and interpretation of a situation, which is highly unlikely among different individuals, where each one holds an individual meaning system (Dweck 2000, p.xi).

A related set of criticism holds that teams and individuals usually tend to protect themselves and their decisions in a self-enforcing system (Argyris and Schön 1996, pp.20-5), Schön 1983, pp.226-31). There is a match between what one thinks is true about the world and the information one seeks, acknowledges and stores as experience; an "incessant stream of confirmations, of observations which verify the theory in question" (Popper 1957, p.102). A phenomena often referred to as "confirmation bias" (Baron et al. 2006, p.518; McKenzie 2004, p.203), which is a tendency to search for or interpret new information in a way that confirms one's preconceptions and avoids information and interpretations which contradict prior beliefs. Disconfirmation as a strategy to test choice would be a suitable consequence, as proposed by Popper (1957, p.100), however, this approach is usually not an option in practitioner methods. Overall, rational choice ignores normative commitment and self-interest, both motivations irreducible to rationality.

3.2.3 User acceptance theories

User acceptance models explain user intentions to use information technology. They represent a mature research area in academic technology research with a focus on information technology (IT). Quite a few of the models are derived from older models; probably most often utilised is the technology Acceptance Model (TAM) from Davis (1986), which is based on Fishbein's (1967), Ajzen and Fishbein's (1973) and Fishbein and Ajzen's (1975) Theory of Reasoned Action

(TRA). The TAM has been further extended to TAM2. In 2003, some of the original authors reviewed eight technology acceptance models and developed the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003).

3.2.3.1 The Theory of Reasoned Action (TRA)
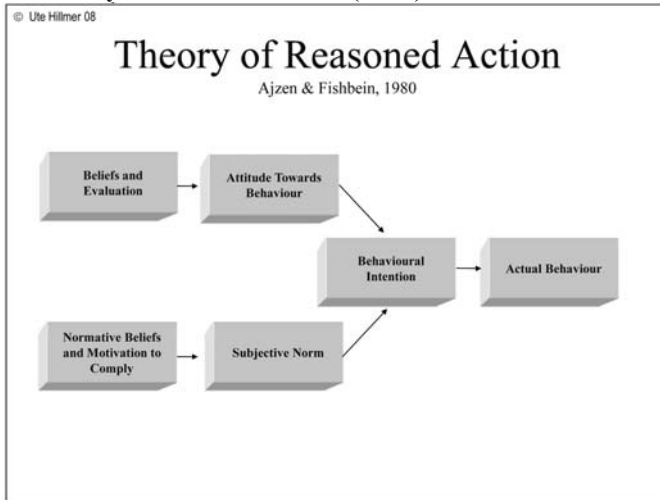
Figure 6: Illustration of the Theory of Reasoned Action TRA.

The Theory of Reasoned Action (TRA) was developed in the field of social psychology, and describes behaviour as a function of behavioural intentions which are also influenced by Fishbein (1967), Ajzen and Fishbein (1973), and Fishbein and Ajzen (1975) in order to explain an individual's attitude toward the behaviour and subjective norms surrounding the performance of the behaviour (see Figure 6). The individual's attitude includes behavioural beliefs and evaluations of behavioural outcomes, while subjective norms include normative beliefs and the motivation to comply.

If a person perceives that the outcome of behaviour is positive, he or she will have a positive attitude towards performing that behaviour. The opposite is true if the outcome is thought to be negative. If relevant others see behaviour as positive, and the individual is motivated to meet the expectation of these others, then a positive subjective norm is expected and attitudes and subjective norms are measured on scales such as the Likert scale. The intent to perform behaviour depends upon the product of the measures of attitude and subjective norm and their weighting (ibid.).

TRA works best for volitional behaviour, which does not usually apply to a situation of technology acceptance in an organisational context. To make the model

applicable for mandatory users, the Theory of Planned Behaviour (TPB) evolved out of the concept (Ajzen 2005).

3.2.3.2 Theory of Planned Behaviour (TPB)

The significant difference between TRA and TPB is the addition of a third determinant of behavioural intention, that of perceived behavioural control, which is determined by control beliefs and perceived power (Bright, 1993). Perceived behavioural control as an independent influence on behaviour recognises the influence of perceived lack of ability to control the execution of behaviour (Compeau et al., 1999, p.146).

3.2.3.3 Technology Acceptance Model (TAM, TAM2)

TAM (Davis 1989) is an influential theory, based upon the Theory of Reasoned Action TAM, but tailored to fit the information systems context. In TAM, an individual's perceived usefulness and perceived ease of use of a particular information system influences its attitude toward using that system, which affects the intention to use the system and, in turn, their actual use of the information system (Shaft et al, 2003). Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance." (ibid., p.320). Perceived ease of use is "the degree to which a person believes that using a particular system would be free of effort." (ibid.).
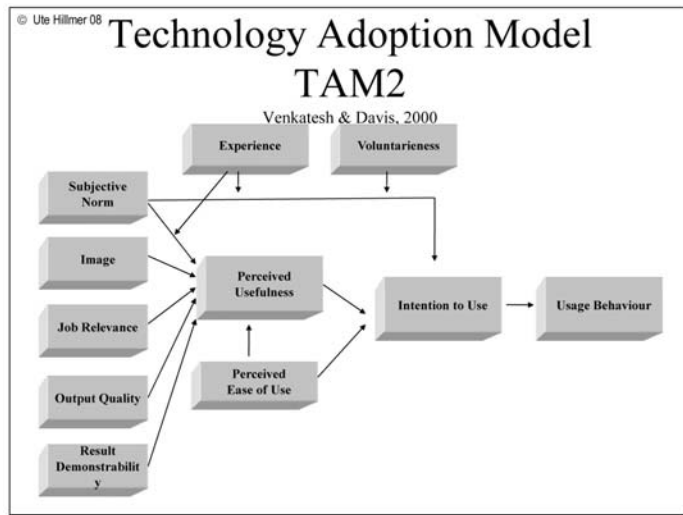
Figure 7: An illustration of the Technology Acceptance Model TAM 2

In a revision, TAM 2 included subjective norms, image, job relevance, output quality, and result demonstrability as influences to perceived usefulness as shown in Figure 7. The direct attitude construct, a determinant in TRA is not included. "A

key purpose of TAM is to provide a basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions. It suggests that perceived ease of use (PEOU), and perceived usefulness (PU) are the two most important factors in explaining system use." (Legris et al., 2003, p.192). TAM seems to suggest that the perceived usefulness construct indirectly incorporates attitudes.

3.2.3.4 Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT (Venkatesh et al., 2003) was developed as a result of a meta-analysis of eight existing technology acceptance models, aiming to capture their essential elements. Conceptual and empirical similarities across the models were used to formulate UTAUT (ibid., p.467).

UTAUT offers three direct determinants of intention to use: performance expectancy, effort expectancy, and social influence, and two direct determinants of usage behaviour: intention and facilitating conditions. Additionally, there are moderating influences of gender, age, experience and the voluntariness of use. Performance expectancy is seen as a strong predictor of intention. It is the degree to which an individual believes that using the system will help to attain gains in job performance (ibid. pp.447, 467). Effort expectancy is another predictor, defined as the degree of ease associated with using the system (ibid., p.450). Furthermore, there is social influence, defined as the degree to which an individual perceives that important others believe he or she should use the new system. Social influence is said to only become significant in a mandatory context, most likely in the form of compliance, internalisation, and identification. Furthermore, there are facilitating conditions, which are the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system (ibid., pp.450-4). Venkatesh et al. claim to incorporate compatibility in accordance to Rogers' degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters. However, this similarity seems farfetched, because "an organisational and technical infrastructure" (ibid., p.453) does not have a lot of similarities with Rogers' original definition of values, past experiences and needs (Rogers, 1995, p.224). The compatibility of values and beliefs refer to an individual's interpretation and applied meaning of the technology. It indicates whether these perceived values are compatible with the individuals' values and beliefs. Venkatesh et al. (2003) claim that UTAUT accounts for 70% of the variance in usage intention (p.467). The model is visualised in Figure 8.
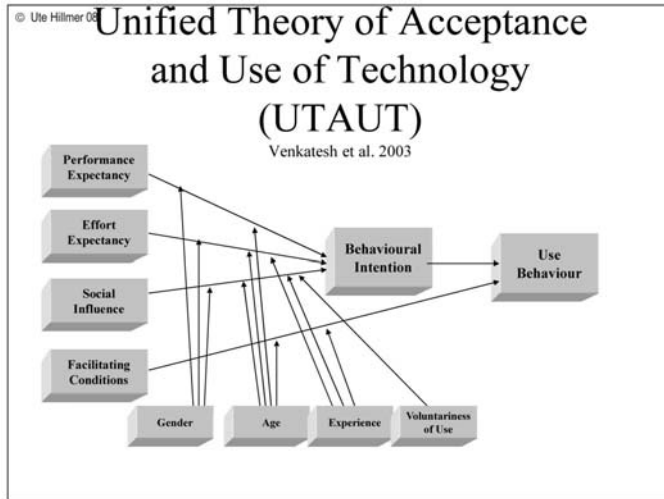
Figure 8: Illustration of UTAUT

3.2.3.5 Discussion of user acceptance theories

While the suggested behaviour determinants of the five introduced models may well be accurate, Likert scales for response collection use only variables explicitly mentioned that are considered in the technology adoption analysis; furthermore, it assumes a common understanding and meaning for all individuals involved, including the researcher. They assume a rational individual who makes systematic use of information, and who considers the implication of any action before engaging.

Such assumptions ignore individual differences and biases as well as the dynamic of social relations inherent in the situation of technology adoption. As outlined in the philosophical position of this study, this work does not deny such behaviour, however it does acknowledges the existence of subconscious action and the "controls of wills" (Bourdieu 2000, pp.170-1; cited in Wolfreys 2000). These ideas believe in the complex and fine graduations of interpretations that get lost in one-dimensional Likert scales, where no motivation for action outside the technology centred questions are registered. Additionally, the suggested questionnaires imply a common understanding. To answer the questions as intended by the researcher, the respondent must share an identical thinking pattern. For example, the questioning 'using the system increases my productivity', in the category of 'performance expectancy' for UTAUT automatically implies that performance improvement is an individual's goal.

Among the models, TPB is an exception in that it incorporates the notion of perceived behavioural control; UTAUT, also offers some moderators outside the

direct technological sphere, but all models judge technology usage by technology determinants. This study will suggest additional factors in which its desired users might judge technology. While a unified, linear measure, embedded in common social understanding, might capture a significant percentage of 'mainstream' individuals, it will not be able to serve its purpose for individuals that do not fit the norm. However, some theorists (Rogers 1995, p.252; Moore 1999, p.1) point out that it is these 'non-mainstream' individuals that play a very significant role in getting technology going.

Discussion of TAM and TAM2

A very pointed critique towards TAM and TAM2 derives from the analysis of 22 research reports, using TAM and TAM2 (Legris et al. 2003). Results are said to be inconsistent or unclear which leads Legris et al. (ibid., p.191) to the conclusion that significant factors are missing. They argue for a broader model including organisational and social factors (ibid., p.202). Besides, preselecting twenty-two from eighty available TAM research reports, still 45% of these reports were conducted with students and most of them with office automation software. Access and cost might be beneficial in conducting university centric research; however, a university context has some significantly different determinants than a business context. Moreover, word processing might no longer represent disruptive technology.

Discussion of UTAUT

The authors (Venkatesh et a., pp.467-70) offer some critique towards UTAUT. They point out that the scaling and the measures of intention should not be viewed as final. Furthermore, they stress that each one of the key relationships in the model is moderated. These moderators, such as age and gender need further investigation. While they point to the role of social influence as controversial and attribute it to older employees and women, the author of this dissertation argues that self reported, conscious social influence might vary significantly from overall social influence which often goes unnoticed, because it is often internalised and taken for granted. This will be particularised in the course of this study where social and individual influences will be emergent and participants are not required to be consciously aware of them. While the authors of UTAUT hint on the complex range of potential moderating influences in their article, the final model and the suggested questionnaire draw a very simplified, extrapolated image of a complex and unique situation.

Questions concerning the social structure are only concerned with direct influence of significant others, the subordinate and the organisations. They do not refer to the overall normative structure of the organisation, nor do they ask how that structure is perceived. The possible significance of work teams is ignored. Facilitating conditions cover the infrastructure available to ensure a functioning system. If the system is perceived as compatible with individual, team and organisational values and goals, it might be an important determinant of system use. An individual's

personal interests could reveal interesting information concerning compatibility of personal goals and system goals, and individual's attitude towards learning something new and unknown often reaches beyond self-efficacy. Experience is another interesting moderator. While experience is presumed to accelerate usage, there are experience destroying and experience enhancing technologies, and this significant determination should be made. While information can only be gathered in a quantitative way with user acceptance theories, the model covers a lot of ground.

3.2.4 Personality theories
Personality theories in technology acceptance research usually work with different personality attributes or traits that are said to have influence on reactions towards disruptive technology, just as they have influence on any other situation of change. They are more generic models of behaviour, which also apply to technological change behaviour.

3.2.4.1 Social Cognitive Theory (SCT)
One very influential, but rather generic model is Bandura's (1977; 1982; 1986) social cognitive theory (SCT), that provides a framework for social action and social learning by attributing it to a reciprocal relationship between the individual P, the environment E and the behaviour B (for more details see the individual chapter, cognitive forms of behaviour).

3.2.4.2 Computer self-efficacy (CSE)
Computer self-efficacy (CSE) puts individuals' judgement of their capabilities to use a technology in relationship to their performance of using it (Compeau and Higgins 1995, p.189; Compeau et al. 1999, p.145); it is based on SCT.

"The model offers insight into the cognitive, affective and behavioural reactions of individuals in technology" (ibid.), thus reaction towards technology is the result of a set of beliefs about a technology and a set of active responses to the behaviour. However, different from the models discussed so far, SCT/CSE see technology self-efficacy as both cause and effect. Past success or failure has influenced self-efficacy and the current success or failure will influence self-efficacy in the future. Thus, the personality factor "self-efficacy" is both cause and effect of technology experience (Compeau et al. 1999, p.146). Figure 9 illustrates the conceptual model of the computer self-efficacy concept; however, it does not reflect the reciprocallity that is inherent in it.
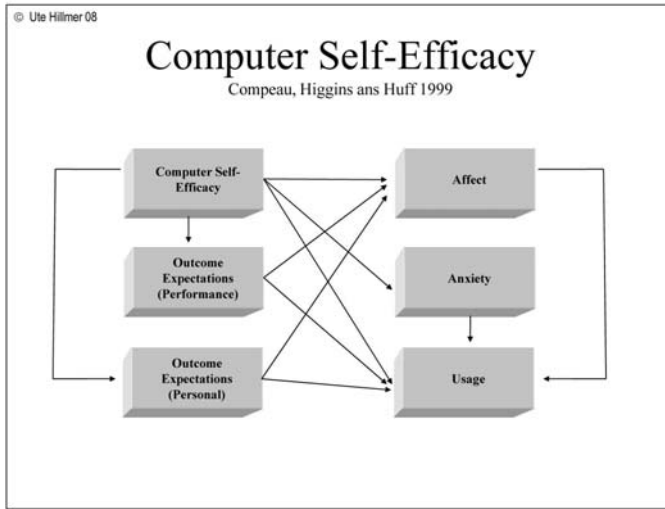
Figure 9: Illustration of the Social Cognitive Theory SCT.

Discussion of SCT

The triadic reciprocallity assumed in SCT is a fundamental assumption that is shared throughout this work. However, the SCT concept does not go far enough to explain all forms of behaviour in response to technological change. It is mainly concerned with cognition. The concept would benefit from a breakdown into components that are more detailed. When behaviour, cognition and environmental influences all operate as interlocking determinants of each other, research becomes difficult. Consequently, most research addresses segments of it. While a segmental analysis is a reasonable way to go, it bears the risk of excluding some of the most influential factors in a particular situation that determine behaviour. An argument for a holistic, qualitative approach is that it flexibly prioritizes the factors most important to explain the case.

3.2.4.3 Personal innovativeness

Roger's theory on personal innovativeness (1995, p.252) contains many elements of a personality theory. This was discussed as part of the diffusion of innovations theory (DOI). There are other personality concepts that are of interest for technology acceptance behaviour but not particular to technology. A discussion of those concepts is part of the individual perspective taken.

3.2.5 Organisational structure theories

'Organisational structure theories' subsumes theories that relate technology acceptance behaviour to organisational culture, structure or values. There are a few very prominent theories that fall into this category: there is e.g. the Schumpeterian

Innovation (Heertje 1981) and the Disruptive Technology Theory (Bower and Christensen 1995) that derived from it.

3.2.5.1 Schumpeterian innovations

There is the rational perception that the economy is the engine for any society. In order to make this engine work, Schumpeter considered innovations to be the propelling element underlying all economic categories. According to his theory, technological innovations appear at rare and irregular intervals in every industry, and they command a decisive cost or quality advantage and strike not only at the margin of profits and outputs but they destroy old ways of doing things and replace them with new ones. When a firm replaces its own competitive advantages through a Schumpeterian innovation, it is "creative accumulation" (Breschi et al., 2000; cited in Baaij et al. 2004, p.519). In the second situation, Schumpeterian innovations by other firms destroy the core competences of leading established firms and hence their sustainable competitive advantage. This is what Schumpeter calls "creative destruction". According to Schumpeter (1942, p.84; cited in Baaij et al. 2004, p.519), technological innovations have a destroying and a building power, which is a critical element for a flexible, modern economy and society. These innovations occur, when knowledge and information act upon knowledge and information, and in this constellation, technology is the tool to make it all work in a faster mode of creative destruction.

3.2.5.2 Innovation Creation Theory

Managing and updating knowledge and its adaptation to new learning is at the centre of Leonard's (1998) "wellsprings of knowledge" investigation. She argues that technology developers must devise and maintain a system of knowledge creation in order to build knowledge assets and to understand them to a great level of complexity. While her argument is that the future can't be foreseen, companies survive on their ability to adapt when necessary, based on the thoughtful application of knowledge assets.

3.2.5.3 Disruptive Technology Theory

The disruptive technology theory combines the nature of organisational processes and that of organisational culture into a theory that relates to innovativeness. Organisational culture and organisational processes influence each other over time and merge to one coherent pattern, defining what an organisation can and cannot do successfully. Maturing companies have over time developed their own specific, successful and thus well-established processes, norms and order. Due to their long-term success, management and employees gradually come to assume that these routines are "the only way of doing things". Once this happens they "begin to follow processes and decide priorities by assumption rather than by conscious choice. These processes and values come to constitute the organisations culture." (Christensen and Overdorf 2000, p.113). This process of 'maturing' has influence

on the way these companies accept technological change and how they are able to innovate themselves.

Discontinuous technological changes usually challenge existing processes and values, and they thus constitute disabilities, which are perceived as competence destroying (Anderson and Tushman, 1990; cited in Nair and Ahlstrom, 2003, p.2). This theory relates technology adoption directly to the degree of competence that is destroyed for an individual, for a team or for an organisation.

Discussion of the disruptive technological change theory
This model of technology acceptance takes the social influence of the organisation as the centre point for its argument, a position that was ignored by all previously discussed theories and that has a lot of merit. However, Christensen does not take account of any other influences, such as the individuals' personalities, the larger society or specifics of the situation. Thus, while the Disruptive Technology Theory adds an important aspect, it should not be considered in isolation and rather be added to other perspectives. This study will attempt to incorporate Christensen's and Overdorf's (2000) aspect of the competence destroying quality of a new technology, however, other than in the original theory, it will be used as a relative value, dependent on the degree, participants perceive the thread.

3.3 Discussion of existing models

The existing theories and models have produced useful insights into the cognitive, affective and behavioural responses of individuals towards new, disruptive technology.

Overall, the models cover many different factors that determine technology acceptance, and no one perspective seems wrong. Table 2 offers an overview. Confronting the range of approaches shows that all discussed models were developed with a particular priority and perspective in mind. There are the marketing and sales requirements of the involved business organisations, e.g. in DOI, the lifecycle theory or the organisational structure theories. Strategic or tactical management goals are the main concern in rational choice theories. The interests of a mechanistic thinking employee are central in user acceptance theories, and the isolated personal interests of an individual or group in personality theories. All models remain mostly one-sided and limited. Furthermore, almost all models assume a mechanistic, rational worldview and interests other than the well-being of the company are hardly recognised.

Each of the discussed models has great merit given the perspective it takes. Depending on this particular viewpoint, some aspects are magnified, certain others are ignored. However, given the complexity of the working context and the situation of technological change, any attempt to seriously understand technology acceptance behaviour in a real-life context must remain open to all perspectives. When analysing the individual actor, his motives, understandings, perceived conscious or subconscious privileges, rights and constrains, all of the above mentioned perspectives are considered. They are considered to the degree, as they actually influence the particular individual in a specific situation, which pays attention to the diversity of situations and the diversity of individuals.

Comparison of Factors Used

	DOI	TRA/TPB	TAM/TAM 2	UTAUT	SCT/CSE	Disrupt. Techn.
Central Influence	Perceived characteristic of technology: Relative advantage; compatibility; trilability observability; complexity.	Normative beliefs: Perceived normative control; perceived behavioural control.	Perceived usefulness; perceived ease of use; subjective. norms.	Perform. expectation; effort expectation		Organisat. values; organ. culture; tech. values
Affective Response		Attitude twds. behaviour; Subject.norms; perceived. behav. control				Change management
Technol. Independ Influences	Relative advantage.	Norm. Beliefs; motivation to comply; control beliefs (TPB).	Tech. voluntariness; experience; tech. subject. norms.	Social influence; gender; age; experience; volition.		Organisat. values; organisat. culture.
Personality Attributes	Degree of innovativeness		Experience; norms.		Self efficacy; affect; anxiety	
Environm. Influence	Diffusion network	Perceived behavioural control	Subj. norms towards technology image			Organisat. values; organisat. culture.
Direction of Influence	Bi-directional	Uni-directional	Uni-directional	Uni-directional	Bi-directional	Uni-directional
Sense Making System	Cognitive; affective	cognitive	cognitive	cognitive	Meaning system	Fit of culture, values and processes

Table 2: Comparison of factors in technology acceptance models

Part II: Methodology

4. Methodology

4.1 Introduction and chapter overview

This chapter outlines the research design and methodology of this study. It explains why the research shows an emerging methodology, it describes the process that led to the selection of this methodology, and outlines the research design.

Given the complexity of the task and the dissatisfaction with existing knowledge, an action research approach has been adopted. This provides the opportunity to look at the problem to see if it could be viewed from a different perspective. Consequently, the literature review is eclectic and dynamic, which is meant to alter the notions of existing research. The consecutive, primary research comprises case data from twenty-two product design engineers and technicians in the mechatronics machine development and building industry of seven different mechatronics companies. These companies are at the forefront of technology innovation and acceptance of new technologies in product design is significant for their business. The data collection and analysis methodology is grounded theory based on action research, and data is derived primarily from extensive, semi-structured in-depth interviews, and an upfront questionnaire. Action research based grounded theory is responsive to situations, thus actions and interpretations are refined during the process. Follow-up telephone and e-mail conversations were used to close data gaps, whenever they occurred during the research process.

The research problem is split into two steps. The first is the introduction of a frame analysis; the need for this was derived from the researcher's own personal knowledge of technology adoption literature and its failure to mirror practical experience in the industry. Therefore, there is a need to use a process of investigation that enabled a wider perspective than is traditionally the case. As a result of the frame analysis, the second step includes a field analysis that investigates the relationship between individuals' subjective meaning that they attribute to the situation of technological change, and its relation to their technology acceptance behaviour. This subjective meaning and the social and individual sources that wield influence are revealed by the frame analysis, which in turn revealed the importance of symbolic interactionism based identity theory and network theory. In combination, they provide the route to a deep analysis of acceptance or rejection of technological change.

The field research explores individuals' construction of meaning, significance and stability, and compares these constructions to technology acceptance behaviour in twenty-two qualitative cases. This research design is primarily inductive and thus

exploratory due to its qualitative line of action, which can offer the depth of information necessary for such an inquiry. Action research based grounded theory is chosen as the method for field data development, because it offers the flexibility and responsiveness necessary for an investigation that utilises the "art of professional practice" hidden in tacit knowledge (Schön 1983, p.18), while at the same time it offers rigour and trustworthiness. Figure 10 illustrates the bricoleur-grounded theory methodology.
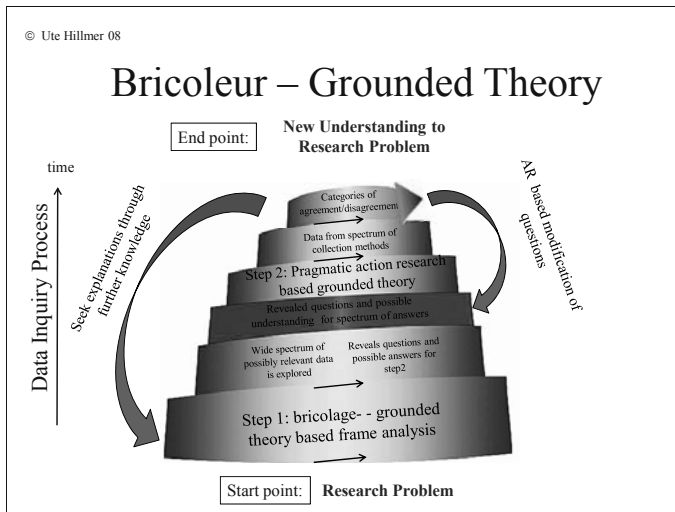
Figure 10: Bricoleur – Grounded Theory Methodology

4.2 Discussing this methodologies atypical approach

The need to pursue an action research approach has been derived from the researcher's anecdotal evidence, but lead to the conclusion that there was indeed a gap in the literature that needed to be filled. It was thus recognised early that a new way of looking at individuals' technology acceptance behaviour might be the way to move forward. Consequently, the main objective of this research is to reveal a new way of looking at an old problem in order to gain a new approach to solving the problem.

Action research (AR) permits an open, responsive, and flexible approach to emergent and changing knowledge, which makes it appropriate for this research problem. It is an iterative process between actions and changing understanding and thus method, data and interpretation of data develop simultaneously from one cycle of understanding to the next one.

While action research has many variations (Saunders et al. 2003, pp.93-4; Newman 2000, approx. p.1), in the context of this business research, action is directed

towards the research and the consequent steps of inquiry. Action is not directed towards changing an immediate business situation. Further details on action research will be discussed later in this chapter.

4.2.1 Research paradigms

As mentioned, the existing business literature does not offer satisfying explanations for the research problem, because the existing body of coherent intellectual business knowledge makes certain assumptions that are usually unrecognised; they are built into the intellectual paradigm that guides the field. This phenomenon is one justification for this research's atypical approach and it will be briefly discussed.

Scientific disciplines are primarily forms of knowledge with a discipline specific structure and content (Becher 1989, p.150). They are launched by a scientific revolution, yet after a period of high intellectual effort, a period of "normal science" (Kuhn 1970, p.131) follows where progress seems both obvious and assured because scientific consensus about the field develops. This rests upon an "intellectual paradigm" (ibid.), a discipline's own specialised and approved ways that provide "the typical scientist with the information he or she needs to reduce the uncertainty of the research process." (Rogers 1995, p.44). It is a source for security and stability in the uncertain world of research. However, this predictability and security comes at the cost of simplified assumptions about the complex reality that it studies. Often these assumptions are not recognized, but they do affect what is studied and what is ignored, which research methods are accepted and which are rejected (ibid., pp.99-100). The intellectual 'blinkers', that exist in all disciplines are "trained incapacity" (Kaplan 1964; cited in ibid.) that make research efficient. However, growth and development of a field can only occur when these assumptions and biases of a scientific field are revealed and open to scrutiny. One way of progressing is by ignoring the 'appropriate' approaches and trying new uncharted paths; a risky undertaking with an uncertain end.

4.3 Emerging philosophy and research perspective for this interdisciplinary management research

This section will detail the emerging research philosophy that dominates this study and will explain the final choices. While the literature search starts as an epistemological and ontological objective search for social and individual influences on technology adoption, this process is modified, as the consciousness of the researcher gets broader and understanding of the complexity of the research problem evolves. A frame analysis is used to enable insight into various, often unusual explanations and solutions of the problem. A multi-disciplinary consciousness develops that combines perspectives and that broadens the consciousness for research philosophies. Figure 11 illustrates the research position in relation to other commonly accepted perspectives.

The frame analysis reveals a "meaning systems approach" (Dweck 2000, p.xi) as most suitable for the research problem, because it enables the discovery of many aspects of an individual's sense making. 'Meaning system theories' are usually embedded in a research philosophy of symbolic interactionism. In symbolic interactionism, meaning is socially created through interacting with others. Since knowledge in personal psychology suggests some underlying, predetermined organic structures and the forms of social psychology and sociology used in this research study acknowledge a shared interpretation of social structures; structured symbolic interactionism is the chosen underlying research philosophy. Since structured symbolic interactionism is not a common research philosophy in business science, the following section will account for the foundation for the research inquiries.

Research Philosophies: Views of Reality

Ontology
"View of the social and natural reality "

objective ———————————————————————— subjective

Positivism	incoherence

Epistemology
"View of the reality of knowledge"

Critical Theory
Realism   Interpretivism
Pragmatic-Critical Realism
Symbolic Interactionism
Pragmatism   Post-modernism

subjective

Source: Content based on work from Johnsen and Dubelrey, 2000 and Saunders *et al.*, 2003

Figure 11: Research philosophies and this research position

4.3.1 Structured symbolic interactionism

Symbolic interactionism is a social psychological theory, which focuses on the ways in which meanings emerge through interaction. It is heavily influenced by pragmatism, which does not accept a division between recognizer (subject) and what is recognised (object), but rather stresses the interaction between the two (Hildenbrand 2004, p.17). It is important to analyse social processes within action and interaction, and to focus on the meaning carried within the interaction, which makes it a suitable perspective for this research. Any meaning inherent in interaction is context specific in nature.

Symbolic interactionism's structured form acknowledges that every individual is constrained by structural rules and processes, as well as material resources (Stryker

1980, p.65). Thus, structured symbolic interactionism is well suited to investigate the subjective interpretation of a situation of technological change. The social structures inherent in the situation through culturally derived perspectives; rules and systems of meaning and their influence; the individual's self-concept and respective identities active in the situation, along with the values and believes, attitudes, problems and perceived choices, and experiences of self-integrity that stabilize or destabilize, can be uncovered.

Symbolic interactionists do not believe that general "grand theories" of social environments are useful (Denzin 2004, p.83). Objectifying and quantifying human experience is doubtful. They would rather summarise, and thus, produce knowledge about the world. Rather than asking "why" (e.g. why are individuals acting a certain way), they believe in the rich contextual information within a "how" question (e.g. how do individuals gain stability?). Since it is not possible to study experience directly, symbolic interactionists study narratives, connected to the systems of discourse in the form of interviews, stories, rituals, and myths, because a meaning system builds on these constructions (ibid. p.85).

While critics point out that symbolic interactionism lacks well-developed concepts, logical models and theoretical rigor, this is outweighed by the tremendous benefit of studying social interaction of "real people" in the "real social world". This opportunity is supported by a method of grounded theory that is often applied in symbolic interactionism. Grounded theory is accepted as a validated and respected approach when it is applied with careful observation, an ability to pay attention to detail, and a consideration of the accepted and routine (Gingrich 2000, approx. p.2).

Limitations for this research when using structured symbolic interactionism
The chosen research approach has its drawbacks: when procedures are emergent rather than pre-established, it is difficult to ensure reliability and since the studies are carried out in specific contexts, external validity and generalisation of the findings are argued to be questionable.

Furthermore, the critique applies that if knowledge is underpinned by values and interests, both researcher and researched ought to be reflexively aware of their own presuppositions and values. This has an impact on the methods used: open and undistorted communication should be at the centre of the investigation (Johnson and Duberley 2000, p.146). Some critics point out that any interactionist's explanation reflects the point of view of the author, because just as any individual, symbolic interactionists have a system of representation that is constantly making sense of a situation. In addition, causal effects are unlikely to be observed directly, because too many factors of a complex situation might exercise influence. Symbolic interactionism can produce knowledge about underlying basic structures and mechanisms but no linear causation.

Nevertheless, these limitations can be addressed because the research philosophy of this work supports this evidence. There is no objective understanding in any

research design (Johnson and Duberley 2000, pp.155-6), because no explanation carries the guarantee of truth and objectivity, when all meaning is interpretive (Denzin 2004, pp.85-6). However, there can be approximations based on a shared reality within a specified culture, but these approximations will only work within a unified, shared perspective. For that reason, case comparison is the predominant way to assess interpretation in this research.

4.4 Research methodology for this management research

4.4.1 Literature review as frame analysis
Frame analysis is not normally adopted in business related research. The following offers a justification for its selection and explains further details. Frame analysis is a process through which the researcher can reveal a new way of looking at an old problem by facing his or her own hidden bias and by unveiling the disciplinary bias, brought about by 'acceptable' ways of constructing knowledge about the problem. This method is applied to this research study because today's existing theories of technology adoption have thus far failed to offer a tool kit that resolves the problem. This is because the underpinning rational approaches capture parts but not the whole of the problematic situation. Simplified and one-sided rational models do not fit the complex features of technology acceptance behaviour, which has led to a crisis of professional confidence by those who are organising technological diffusion with the models offered. This understanding follows Schön (1983, pp.31-6).

He experienced that professional knowledge is "mismatched to the changing character of the situations of practice – the complexity, uncertainty, instability, uniqueness, and value conflicts which are increasingly perceived as central to the world of professional practice" (ibid. p.14). A situation, where the task no longer fits theory and education or theory and education no longer fit the task (Brooks, Dean of Harvard University; cited in ibid. p.15).

Consequently, creative professionals develop their own "art of professional practice" (ibid., p.18), which are intuitive processes that help them deal with the complexities they face. In this situation, knowing is in the action rather than in a conscious cognitive process. Unfortunately, this kind of skilful action comes with the uncomfortable experience that one knows more than one can say. The experience cannot be categorized, let alone generalized. However, the reflective understanding emerges that these processes are worth exploring in order to transform "knowing-in-action" into "knowledge-in-action" (ibid., p.59). This places the research study in the realm of action research; a process through which tacit knowledge can be explored (Argyris and Schön 1996, p.35; Levin 1946; Schön 1983, pp.49-55). Action research methodologies are responsive and flexible, which allows immediately to apply new learning to the next step of inquiry and new knowledge and understanding grows as the research progresses (Dick, 1999, approx. p.2).

Different techniques of action research are required to collect the scattered fragments of ideas and knowledge distributed into various disciplinary "archives" of a society (Foucault 1972c, pp.246-7). Thus, the method of frame analysis is used to investigate a variety of theoretical fields to understand different perspectives. In this way the researcher is liberated from the confines presented by accepted ways of knowing about the subject; an exploration of alternative knowledge domains sets free tacit knowledge and broadens consciousness that eventually enables the researcher to reframe the research problem creatively without losing relevance. Given this new consciousness, the methodology for the field research has been selected as stated above.

4.4.2 Methodology for the field research
There are different, but not mutually exclusive types of inductive, qualitative research strategies that can be used to investigate an individual's construction of meaning. This section outlines the rational to choose a qualitative case-study investigation through grounded theory.

4.4.2.1 Case study research
Case study research is "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence." (Robson 2002, p.178; cited in Saunders et al. 2003, p.92). It is particularly well suited to develop a rich understanding of the context and enacted processes. Case study research can develop meaningful data to "why?", "how?" and "what?" questions, however, developed data and deduced understanding depends on the context from which it is derived, so the depth comes at the cost of extrapolation of the findings to a wider population.

In contrast to surveys, case studies attempt to assess a cluster of factors rather than single data points by focusing only on a small number of cases. In order to generate great depth, various data generation methods can be used in triangulation. Case studies vary in character, and two of the possible distinctions are of interest in this research study. Yin (1994, p.13) determinates between exploratory, descriptive, and explanatory research. The field research of this study is exploratory in nature. While the frame analysis of the research problem uses the researcher's ability to reflect, explore and describe existing explicit and tacit knowledge. Another differentiation of case studies is more straightforward: it is the question of whether the study attempts to derive more general conclusions from a limited number of cases, or find a specific conclusion to a single case (Gummesson 2000, p.84). While the conclusion in this frame analysis is specific to one case, the study attempts to gain a more generic conclusion in the field analysis. As Odman (1979, pp.106-84; cited in ibid.) points out, both methods may produce results of general interest.

4.4.2.2 Grounded theory combined with action research
Different approaches are suitable to develop and analyse data about an individual's construction of meaning in a case structure. This study will use grounded theory in combination with action research, and the building blocks for this method are described in the following sections.

Action research or action science
Action research is also known as reflective practice (Schön 1983) which means it can be interpreted in various ways (Saunders et al. 2003, p.93-4; Newman 2000, approx. p.1). This research can be described as "practice-as-inquiry" (Newman 2000, approx. p.1) and is closely linked to reflection-in-practice. Above all varieties, action research is responsive and flexible, thus suitable for complex, and instable situations; it allows the dynamic reframing of problems with new experience. Furthermore, it can make "non-logical processes" observable, even so they are not immediately capable of being expressed in words or as reasoning (Barnard 1968; cited in Schön, 1983, p.51): judgment, decision or action and expressions such as 'having a feeling for the customer', "… a feel for the music", ". a feel for the ball" (ibid.) are examples for knowledge gained from action research in the most practical sense.

Critics point out that action research is limited to uncovering causal relations, because it is focused on cases, and thus only allows restricted generalization. Other than in an experimental set-up, "the practitioners hypothesis testing consists of moves that change the phenomena to make the hypothesis fit. The practitioner violates the canon of controlled experiment, which calls for objectivity and distance." (ibid., p.149). This critique has to be acknowledged because the produced knowledge is only objective within the frame that produced it, yet, within a subjective epistemology, this is true for any body of knowledge.

In this field study, action research is applied because it continues to allow emergent understanding to be further and deeper investigated, which is an appropriate approach when the research methods do not follow a theoretical paradigm of well-experienced and proven paths.

4.4.2.3 Grounded theory
Grounded theory is a research methodology and data analysis technique that attempts to combine a naturalistic investigation approach with the academic concern for a systematic set of procedures in obtaining qualitative research. Using grounded theory, theory emerges inductively from a corpus of data (Dick 2005, approx. p.10) by constant comparison of data and later by comparing data to emerging theoretical code. "A theory must have fit and relevance and it must work. Grounded theory meets these criteria because it is generated systematically from research data." (Glaser 1978, p.4).

The fit of grounded theory as a research method comes from various aspects. The basic concepts rest fundamentally in symbolic interactionism which means that an

analyses of the social processes within their frame of action is possible, and the relevant context (interaction, time, process and structure) is automatically there. Additionally, research results are not separated from the researcher's meaning. It is the same individual that reveals the data, that applies a structure to this data and that analyses and discusses the data. Furthermore, it is a strategy that helps make implicit beliefs explicit by addressing structural conditions that emerge in comparison (ibid.).

Grounded theory is often used for inductive research, but it also works as a test for a speculative theory. Rather than testing a few propositions, it gives a 'whole' theory that fits and works in a substantive or formal area (Glaser and Strauss 2008, pp.29-30) once the ideas have earned their way into the theory through emergence or emergent fit (Glaser 1978, p.8). The frame analysis of this research followed an inductive-deductive rhythm of inquiry, resulting in new understandings that framed the research problem new. Testing if newly gained understandings are relevant is a deductive approach, while the further inquiry of understandings and their covariance is an inductive approach. Grounded theory allows interweaving of both approaches.

Processes in grounded theory

To ensure that high quality data emerges, some basic processes are essential to grounded theory. Grounded theory uses specific strategies to ensure methodological rigor, one of which is the "constant comparative method" (Glaser and Strauss 2008, p.102), that unites coding and analysis. Usually, the researcher takes several cases and compares them. Cases that all have the same outcome are examined to see what conditions they have in common (Borgatti n.d., approx. p.1), or cases with varying outcomes are analysed for their differences. Both practices will be used in this investigation because this constant comparison is at the heart of the grounded process and theory emerges.

Open coding and selective coding

The process of comparing data to data or data to code, is called "open coding" (Glaser 1978, p.56). This is the initial process of generating an emergent set of categories and their properties; a process of sampling in order to find out which directions work and seem relevant (ibid. 46). While initial codes emerge very quickly, they increasingly need trimming and fitting, a process, which leads to discovering the core variables: the basic social problem, process and data's true relation to these core variables if it is not core itself (ibid. p.61).

 "Selective coding" is a consequent step, where the emergent core variables guide further data collection and theoretical sampling. At this time, data collection can be adjusted to incorporate new understanding and to ensure a further, deeper understanding. It is usually during this process of coding that certain theoretical claims emerge. Theoretical claims may be about categories (variables) that appear central or about relationships between categories (Dick 2005, approx. p.2). In

parallel to data collection and coding, these theoretical claims are captured in memos. According to Glaser, (1978, p.83) these memos are of key importance to develop theoretical code and a grounded theory (see coding notes for this research in the data analysis). At one point, core categories and their linked categories saturate (ibid. p.64) and notes and memos must be sorted. Categories and properties emerge, and together with their links to the core category, they provide theoretical code. Once this has emerged, one compares available new data to theory (Dick 2005, approx. pp.2-3) and data is more selectively used.

Theoretical coding
The role of theoretical coding is to conceptualise how the substantive codes relate to each other. They become the hypotheses that go into the theory (Glaser 1978, p.72). The family of theoretical codes is a powerful approach for theory generation. When excitement about emerging theory takes over, experienced grounded theorists recommend caution: covariance or maybe cause, rather than cause and anticipated effects are usually observed, but this point is easily lost. Describing the situation as a covariance that includes connected variables without the forced idea of cause is a powerful idea (ibid., p.73-4). When coding data, two types of categories can emerge: sociological constructs or "in vivo codes" (ibid., p. 70). The latter is taken directly from the interviews. A comment such as "You can change yourself to suit the situation, or you can change the situation to suit you" is an example for an "in vivo code". Emergent social constructs can be e.g. an emergent differentiation between role-identity and group-identity. When data emerges that fit social constructs, these categories can be adopted.

Emerging typology
Emerging categories can suggest the construction of a typology. These typologies are based on differentiating criteria that earned their distinction through emergent data (ibid. p.65). This was also true for this research and the data analysis will discuss it in detail. Glaser (ibid.) points out that when "running through the minds of people we study", one experiences them usually as social types. This typology has to develop in a phenomenological way, and should never be analytically constructed (ibid., p.68) in order for the emerging theory to be relevant and important.

The role of literature
The role of literature in grounded theory is twofold: traditionally, it is accessed, as it becomes relevant, because one does not know upfront what literature is applicable (Glaser 1978; cited in Dick 2005, approx. p.7.). Others argue for prior background reading in order to provide the models that help make sense of the data (Strauss and Corbin 1997; cited in ibid.). Wide reading and avoiding literature most closely related to the research topic is a recommendation to avoid research paradigms that influence and constraint coding and creating memos (ibid.).

Avoiding the literature most closely related to technology adoption is a means that is further described in the course of action for the frame analysis.

4.4.2.4 Combining grounded theory with action research

Table 3: Characteristics of grounded theory vs. action research

	Grounded Theory (GT)	**Action Research (AR)**	**Grounded Theory with AR**
Author	Glaser and Strauss (1967)	Levin (1946); Schön (1983)	Dick (2000)
Method	Inductively discovering theory implicit in data; theory emerges from compared cases by accumulation of open codes and code notes.	Spiral of planning, action, fact-finding. Duality of action and research.	Inductive, deductive approach; e.g. convergent interviewing were interviews begin open ended and later interviews have more probe questions
Aim	Making implicit beliefs explicit.	Develop knowledge + understanding as part of practice; learning about a social system and simultaneously trying to change it.	Making implicit beliefs explicit while probing an emerging theory.
Advantage	Makes the implicit explicit; considers the situation; makes sense of actual experience; reveals causes; overcomes some researcher bias.	Linking action to outcome making sense of actual experience; dyn. reframing of problem with new experience; focus on change; suitable for complex, uncertain and instable situations.	Combination of GT and AR; while uncovering causal relations
Disadvant.	Specific to situation, thus restricted generalisation; pragmatic data rigor	Few causal relations; Specific to situation, thus restricted generalisation; pragmatic data rigor.	Specific to situation, thus restricted generalisation; pragmatic data rigor.

A research method described by Dick (2005) combines grounded theory with the reflexive flexibility of action research for "convergent interviewing" (approx. pp.8-

9). The method is based on probing questions to seek explanations to similarities and differences that occur: an agreement is probed to seek exceptions to the agreement, and a disagreement is probed by questions that seek to explain the difference (ibid.). This combination alternates deductive-inductive approaches, while the developed theory emerges in the process. Both methodologies are suitable for complex situations with non-obvious intangible components, where new learning and new theory collaborate to gain a deeper understanding. While action research helps to adjust the study constantly to new findings, causal relations can be further understood by the comparative quality of grounded theory. Combining grounded theory with action research attempts to combine the strength of each of the approaches in overcoming some of the weaknesses inherent in each. However, some weaknesses remain, and generalisation remains restricted to the situations, because the results are highly situational and context specific. Table 3 summarizes the characteristics of grounded theory, action research and the combination by a comparison of the method, aim and advantages vs. disadvantages.

4.5 Research outline

The first step in the research study is to re-frame the research problem through a broad, multi-disciplinary literature review. The second step is to conduct field research, which will involve twenty-two individuals who are product design engineers and technicians in the mechatronics machinery industry. An overview of this research's methodological steps is shown in Figure 12.
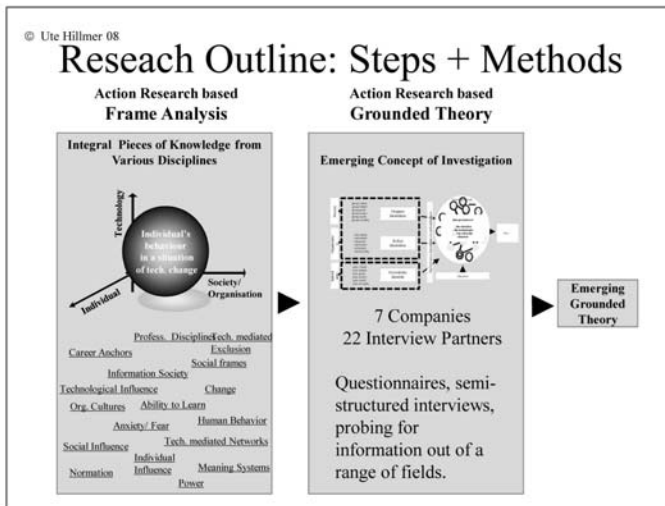
Figure 12: Research outline: Steps and methods

4.5.1 Step 1: Literature review as frame analysis
A large part of the literature review is conducted using a frame analysis, where new perspectives will offer opportunities that indicate what categories and features of the situation become relevant, and what questions to ask outside an existing research paradigm. Gummeson (2000) refers to the process as "from pre-understanding to understanding" (p.57); a "hermeneutic spiral" (ibid, p.71) which circles from pre-understanding 1 to understanding 1 to pre-understanding 2 to understanding 2 to pre-understanding 3 … once again, a process that is never really final, and thus has to be cut at one point. The spectrum of theoretical knowledge in this frame analysis will cover a societal perspective, an individual perspective and an organisational perspective.

4.5.1.1 A multi-disciplinary, multi-perspective bricolage
Gathering understanding from three scientific domains is interdisciplinary research. Lévi-Strauss, introduced the term "bricolage" to the social sciences to contrast the "analytic methodology of Western science with an associative science of the concrete practiced in many non-Western societies" (Turkle 1995, p.51). A process of arranging and rearranging, the bricoleur tries one thing, steps back, reconsiders, and tries another; Lévi-Strauss (1968, pp.16-33; cited in ibid.) called it a concept of "a savage mind" with some key characteristics: "it expresses itself by means of a heterogeneous repertoire which, even if extensive, is never the less limited." The 'bricoleur' is adept at performing a large number of diverse tasks; but, unlike the engineer, he does not subordinate each of them to the availability of raw materials and tools conceived and procured for the purpose of the project" (p. 19). The term, borrowed from the French "bricolage" or "bricoler", means "do-it-yourself" at its core, but also "fiddle, tinker", "make creative and resourceful use of whatever materials are at hand, regardless of their original purpose". While some authors stress the rule of the game as "a make do with what is at hand" (Varenne 1999), this research understands bricolage as a process, where the bricoleur invents with the materials collected and reflects upon what evolves. However, it is not a random process; as Turkle (1995) puts it: "bricoleurs approach problem-solving by entering into a relationship with their work materials that has more the flavour of a conversation than a monologue." (pp. 51-2). Bricolage is a clear contrast to a theory-based, rational construction used in most sciences.

Bricoleurs do not respect disciplinary boundaries. They cross over between disciplines, "borrowing intellectual traditions and illuminative insights from one discipline which might inform the insight of another" (Denzin 2004, p.53). Strict and rigid boundaries between academic disciplines begin to blur, and disciplinary boundaries may eventually even collapse (ibid.).

When Foucault (1976) described parts of his research as "fragmentary, repetitive and discontinuous" (p. 79), in his words a "genealogical history of the origins of a theory and a knowledge of abnormality and of the various techniques that relate to it" (ibid., p.78), he describes some of the same core characteristics of bricolage. He

argues that, "we need to discover how we can group together what we have to work on" (Foucault 1972c, p.247) because "the unity of history is shattered" (ibid. p.246). He points to the difficulties of such an approach, when he discusses the validity of an academic methodology to be "dependent on the approval of the established regimes of thought" (1976, p.81).

4.5.2 Step 2: Field data development: Grounded theory combined with action research

4.5.2.1 The sample

As the work of Becher (1989) suggests, some work related social identities are likely to differ between industry sectors and professions. In order to uncover patterns that emerge between social identities and technology acceptance behaviour, the overall range of possible social identities in the working context has to be limited in order to reduce complexity. Only within a repetitive structure can similarities and differences be compared and can new understanding emerge.

The German mechatronics machinery industry has been chosen as an industry sector, and the participants are product development engineers or technicians. The mechatronics industry sector was selected, because it is at the forefront of accepting new technologies as work tools in an established and traditional sector. In this sector, design tools are significant to initiate further innovations. The sample consists of seven south-German mechatronics machinery companies that develop and manufacture high-tech machines for industries, such as automotive manufacturing or medical technology manufacturing. The selected sample varies in size: there are two small companies (8-30 employees), four mid size companies (300-1000 employees) and one multi-national multibillion-Euro company with 400.000 employees. This variation in size was selected in order to investigate a possible influence of organisational culture on behaviour. As the organisational perspective revealed, differences in sizes are usually linked with cultural differences.

Twenty-two development engineers and technicians of the product development departments were chosen for the investigation. This profession has been and will continue to be confronted with frequent technological change in their work tools. There is variation in the engineering work task between the samples, which allows a comparison among the group of mechanical, electrical and programming focused designers and between them. Six individuals worked at integrated, mechatronics design tasks, ten were mainly concerned with mechanical tasks, five were electrically and electronically focused, and three were concerned with automation and software development. This mix represents the typical mix of disciplinary work within mechatronics machine design.

A key criterion for the selection of the samples was the observed technology adoption as it was seen by their management. In order to compare different behaviour, the research aim is to get a variety of acceptance behaviour in order to

investigate the differences. The targeted spectrum ranged from (1) enthusiastically adopted, (2) went along with the change without further objections, (3) initially critical but changed later towards acceptance, (4) initially went along with the change but rejected later and (5) rejected from the beginning. The management information will only be used for the pre-selection and self reported data will be used in the analysis.

The sample is typical for the overall demographic structure which is male and from the Caucasian race. Three of the individuals were born and raised in non-German, however in European countries. Eight interview partners are in an age range of 30 to 39, fourteen were between 40 and 52 years old and five individuals were over 55 years old. There is some diversity of designers in the industry (female, various nationalities and races), but they were not available for this research study.

Further details of the participants and their companies, such as company or participant names will not be revealed in order to protect the individuals' privacy. All abbreviations of names will be disguised. Most participating companies' design departments are small, and with some of the additional data that will be provided in the analysis (age group, engineering discipline, behavioural descriptions, teams within one company), individuals' anonymity will be at risk.

4.5.2.2 The mechatronics machinery industry

Mechatronics

Mechatronics can be seen as an emergent discipline and a growing industry sector. The portmanteau "mechatronics" was coined at the end of the 1960's in Japan to describe electromechanical systems. The rapid increase of hybrid systems that combine mechanical, electrical, electronics and control software have increasingly led to the understanding that the most efficient and successful machine design should be achieved by a synergistic product design, a mechatronics product design. Figure 13 illustrates the components in the American tradition.

In contrast, the German tradition merges the electronic and electronics segment to one circle:

> *Mechatronics stands for the integration of the disciplines of mechanical engineering with mechanics, precision technology and drive technology, electrical engineering with performance and microelectronics, and information technology with automation and software technology.*

> *VDMA 2003, p.2*
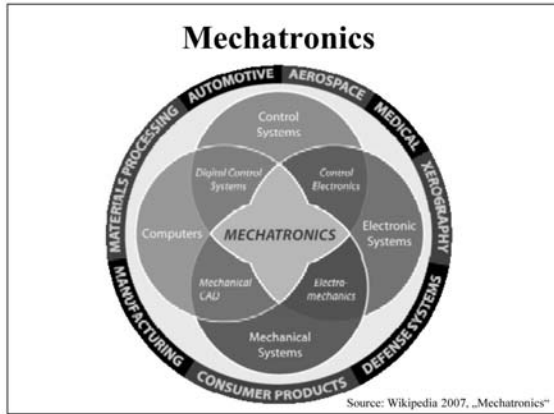
Figure 13: Components of mechatronics in the American tradition

In the past, and in the majority of cases today, when developing large production machines successfully, the disciplines of mechanical engineering, electrical engineering, electronic engineering and software engineering are all involved; however, the process is usually sequential, with time and cost consuming revision loops, until all necessary aspects are combined into the final design. Development teams traditionally have members who have been trained in one of the various disciplines, because of the segmentation of engineering disciplines, which begins with specialised education. In Germany in 1995, the University of Esslingen was one of the first universities to offer the joint discipline of mechatronics, attempting to equally train students in all three mentioned areas and to enforce systemic thinking. The school emphasises that hybrid and systemic training increases the holistic and integrated product design. The willingness to accept problems that go beyond the own areas of knowledge and that require multidisciplinary thinking increases, which it is a significant benefit for project managing any complex hybrid technology design. However, it does not replace the highly specialised mechanical, electrical or electronics engineer and the programmer (Würslin 2008, head of the mechatronics department, University of Esslingen, pers. comm., 17 March 08).

The specific mechatronics machine design process
The groups of interest in this research are members of work teams participating in the development and construction of high-tech machines who are a technological merger of mechanical, electrical, electronic and programming capabilities. Those development teams hold the combined knowledge of mechanical, electrical, electronic and automation design, however, each designer usually was educated in one discipline and focuses on one discipline in his design work.

The organizational goal of the teams is usually to become efficient in the development of competitive machines or machine parts that fulfil a given task. So

far, product design was, and often still is, a sequential process from mechanical design to automation, the electrical and electronics design finally some programming. Today, time-to-market and cost demands are changing product development in two dimensions. Over the past 30 years, design shifted from paper and pencil design and real model prototyping to technology enabled 2D and 3D computer aided design (CAD) with virtual models and virtual prototyping1. Technical advances increased information management capabilities and enabled electrical, electronic and programming considerations at an earlier stage of mechanical design concepts; a process change called "parallel product design" (JPR Research 2008). The discipline of mechatronics addresses this synergy of knowledge, and aims to produce knowledge that not only changes the working sequences, but that also increases the systemic thinking in the various development disciplines when designing a product.

Technological changes for mechatronics machine designers
These ongoing changes imply two things: first, what used to be designed on paper and with real prototypes vanished into a simulated, virtual world. All sense experiences other than the visual dimensions disappeared. Second, what used to be clearly separated by engineering disciplines is now increasingly forced to merge, often initiated by technological tools that offer or demand a combined perspective. Usually, individuals continue to work primarily in one engineering discipline, but they have to increasingly bridge disciplines in their conceptual thinking.

In short, the working environment of machine design engineers has changed rapidly over the past 30 years, and industry trends give no indication that the rate of change will decrease. Rather, the changes may happen even faster and more significantly in the future.

The south-German mechatronics machinery building industry
The south-German mechatronics machinery industry has been selected for various reasons. The industry's design departments work tool innovativeness is overall very high, as noted above. In particular, the German mechatronics industry is anxious to defend its worldwide leadership position, which is under significant international competitive pressure. To defend the position successfully, technological innovations in the product development process plays a strategic role and the investment in new technologies is ongoing (Kaiser, 2006, p.257). Thus, the industry sector is highly innovative, and German patent registrations, which is second to the US has eight mechatronics industry segments that lead the registry before the first non-mechatronics industry is listed (German federal ministry of economics and technology 2006, p.14). Additionally, the increasing reciprocal

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[1] In 2007, 63% of computer aided design (CAD) users worked in 2dimensional design (2D), and 37% worked in 3 dimensions (3D). The market for CAD software was growing 20% in 2007 and is expected to grow 15% in 2008 (JPR Research, 2008).

interpenetration of mechanical, electrical and electronical design activities demand ongoing changes in the previously separated design tools of the three disciplines. While at the same time innovations in mechatronics design tools increasingly combine the design processes (Kaiser 2006, p.257). Finally, the machinery industry in Germany is a highly successful cluster and competence network in South-West Germany (the larger region around Stuttgart), with a vast amount of supporting industry sectors and service industries, as well as research institutions. Market leaders such as Daimler, Porsche, Bosch, Trumpf, Festo and their suppliers are all located in this cluster.

4.5.3 Data development for the field research

In grounded theory, the traditional steps of research plan, data development and data analysis are changed. Data development and data analysis occur simultaneously. This section will discuss the sample and the data development methods, while the data development will be presented together with the data analysis in the analysis chapter.

4.5.3.1 Data development methods

When using grounded theory, no one kind of data for data collection is necessarily appropriate. Different methods to develop data are used to give different "views or vintage points" (Glaser and Strauss 1967, p.65) that are called "slices of data" (ibid.). This research study obtains "slices of data" by the triangulation of data-development methods that includes a questionnaire, face-to-face semi structured interviews, and qualitative test methods from psychology.

Questionnaire

Questionnaires are commonly used in quantitative survey methods, however, a questionnaire is used in this case study research to gain data about individuals and to explore relationships between some fixed variables of self-reported technology adoption behaviour, in an economic and time efficient way. A translated version of the final questionnaire is in Appendix 3.

Face-to-face semi-structured interviews

A qualitative interview is a purposeful discussion between two or more people, and it allows for a rich and detailed set of data (Saunders et al. 2003, p.245). There are multiple reasons that make semi-structured interviews a suitable data development method for this study. Semi-structured interviews are well suited to explore the deeper context, as they help to understand the respondents' meaning system, and they create an understanding of relationships between individuals and situations (ibid.). The understanding of behaviour in context is crucial for this research study. As Boeree states :

> *People are not rocks. Our lives are infinitely varied and in constant motion. No person is quite like any other person. No moment is quite like any other moment. We are more like whirlwinds. If we perceive*

> the goal of the human sciences to be the prediction and control of human lives and the scientific method the means of accomplishing that goal, we are ignoring our natures. We are trying to pin down the whirlwinds when without movement whirlwinds cease to exist.Boeree n.d., approx. p.9

Semi-structured, in-depth interviews offer rich emerging data without losing relevance by dispersed content. They allow flexibility and fluidity in addressing the areas to be covered and the way they are approached, which is of particular interest in an action research based interview structure. Probing to explore areas of relevance within a wider spectrum is possible. Besides the data that emerges from the conversation, the language used and behavioural cues can be used as additional data (Saunders et al. 2003, p.262).

Furthermore, technology adoption behaviour can be viewed as a sensitive and stress-prone area of behaviour. The researcher's past experience with in-depth and semi-structured interviewing techniques, as well as her professional and cultural background as a German engineer suggested sufficient competence to establish a personal relationship of trust and respect with interviewees, which may result in access to high quality, sensitive content data. Appendix 2 offers the questions that will be covered in the conversations.

Limitations of interviews are linked to the researchers interviewing competence. The ability to use and understand the appropriate language is important (ibid., p.261). Furthermore, interview data is self-reported data, which can be distorted or misleading. To minimise such limitations, the data from twenty-two cases are compared, and triangulated data is developed. Furthermore, upfront management observations are considered.

Qualitative methods from psychology
Identity and personality research is primarily the domain of psychology. In order to remain truly interdisciplinary, selected qualitative psychological methods will be analysed to gather further insight into individuals' identities and realities and in order to validate emergent theories by triangulation (Kelle and Erzberger, 2004, p.174). "If… then…" investigations are a self-encoding approach to conceptualise personal structure in its distinct context. The approach is said to reveal individuals' distinctive, highly contextualised but stable patterns of situation-behaviour relationships (Mendoza et al. 2001, p. 533). It is used in three structured interview questions. Additionally, respondents are asked to answer the "Twenty Statements Test" (TST) (Kuhn and McPartland, 1954), also known as "Who am I"-test, which is rather simple and convenient to conduct and provides a relatively direct measure of one's self concept (Nass 1961; cited in Alm et al.). It is a separate sheet of paper, on which the respondent is asked to give twenty answer to the question "Who am I?" in any random order.

4.6 Confirmation of research results

It is vital to have confidence in data and the respective findings, and researcher want those who read the work to share this confidence. This section will discuss the quality of the collected data. The most commonly used measures to confirm the credibility and rigor of research findings are validity and reliability.

Validity, reliability and trustworthiness of results

Validity is the degree to which data collection methods accurately measure what they were intended to measure. From a positivist perspective, validity calls for rigor in the application of methods and strict cause-effect causation ought to be portrayed accurately (Saunders et al. 2003, p.492). Since this study attempts to uncover deep covariant processes that influence behaviour, its prediction and understanding are beyond the symmetry assumed in statistical and mathematical techniques (Johnson and Dumberley 2000, pp.169-70).
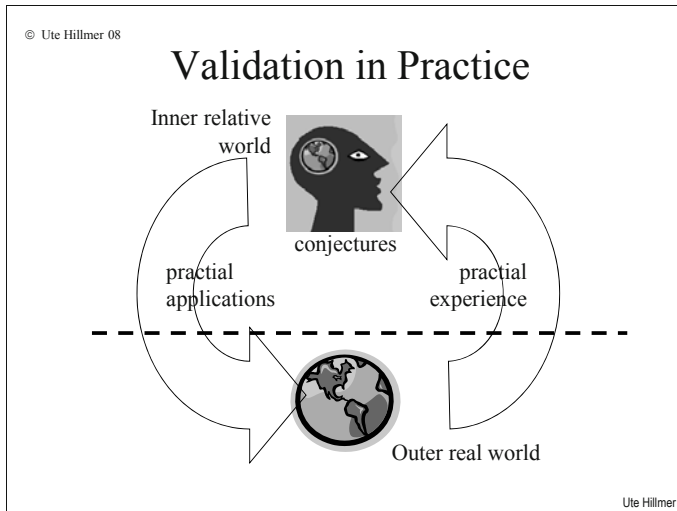
Figure 14: Validation in practice

In order to develop trustworthy results, methodological triangulation is applied, which helps to add rigor, breath, richness and depth to the inquiry (Denzin and Lincoln 2000, p.5). While technology acceptance behaviour is too complex for a linear causation, credibility comes when constructions are plausible to those who constructed them (ibid., p.141). Thus, the notion of external validity and transferability must be rejected: non-standardized methods are "not necessarily intended to be repeatable since they reflect reality at the time they were collected, in a situation which may be subject to change" (Marshall and Rossman 1999; cited in Saunders et a., 2003, p.253). High quality results are also maintained through

anticipatory accommodation, where researchers use their knowledge of a variety of comparable contexts to begin to assess their similarities and differences (Kinchloe and McLaren; cited in Johnson and Duberley 2000, p.141). Grounded theory ensures rigor and validity through one single coder in code analysis and code development. This works, because content analysis procedures or coding techniques are "explicitly perspectival" (Tucker 1972, p.313), and any coder other than the respondent "imposes the meaning of each of [the responses] from his own perspective" (ibid.).

This study is based on action research and grounded theory. The rigor in action research lies in an ongoing reflection-in-action, and the constant conversation with the situation. Its success is validated in action, using the feedback mechanisms of an independent reality (Johnson and Duberley 2000, pp.162) as illustrated in Figure 14. What is deemed unsuccessful action in respect to the set objective, can be reflected and corrected. In that respect, theories in management are validated in action (Gummesson, 1991, p.93).

Timing
The research is cross-sectional, which means it will be conducted at a single point in time, and will investigate past behaviour. This constellation is due to practical constraints and it brings along some consequences for the results. Cross-sectional studies do not give clear answers to many "why" questions. It is not clear, if an individual choose a particular organisation and its culture because of his or her existing identity, or if he or she gain an identity at least in part, because of the membership in the organisation. If there is a cause and effect relationship, this research cannot detect it. Only longitudinal research can add such time-sequence information (Agarwal and Prasad 1998, p.27; Rogers 1995, p.123). Since this research investigates past behaviour, the elapsed time from when a new product-roll-out took place varies. This results in a variation of time, spent with the new technology and a variety of time available for reflecting on own acceptance behaviour. Generally, the recall of perceptions and respective behaviour in hindsight is not completely accurate (Menzel 1957; Coughenour 1965; cited in Rogers 1995, p.122).

Falsification
As explained under the topic of reliability, case study research methods reflect reality at the time data are collected in an open social environment, and they therefore do not intend to be repeatable (Marshall and Rossmann 1999, cited in Saunders et al. 2003, p.253).

4.7 Reflecting on chosen methodology and methods

The structure of this methodology deviates from the norm in business science because the research is emergent. It emerges out of a process that challenges existing notions and that amplifies consciousness. Reframing the research problem

from various perspectives is achieved by an eclectic literature review in the dynamic format of a frame analysis. The researchers practical experience conveys in this process because reasons are given to intuitions (Schön 1983, p.93) through a wide spectrum of theoretical sources. While the frame analysis is guided primarily by intuition, this intuition is validated or falsified in the field research. It is a valid single case method, grounded in practice, in order to reveal a new approach and to increase the understanding about influences on technology adoption. Both Dick (1999) and Schön (1983) support this approach to be particularly valuable when practitioners become reflective researchers "in situations of uncertainty, instability, uniqueness, and conflict" (p.308).

The newly acquired knowledge and understanding sharpens and increases the consciousness for the attention and understanding of a spectrum of details that might have gone unnoticed without an upstream frame analysis. More detailed background knowledge increases understanding, and guides interpretations. The new consciousness and theoretical understanding is empirically validated. This is achieved in a grounded theory based field research were a wide spectrum of possibly relevant data develops through a variety of rich data development methods: They were face-to-face semi-structured interviews, a questionnaire and some selective methods from personality research. This spectrum of data from various methods incorporates multiple views from which to understand the research problem, it is open to allow for aspects to emerge that are unexpected yet promising, yet it offers enough structure to remain relevant. While the choice of data development methods is multi-disciplinary, they all support a qualitative, context and situation related data collection, and all data is suitable for the constant comparison method of grounded theory.

Rigorously applied constant comparison processes of grounded theory result in emergent theories that defy the demands for a valid methodology. Furthermore, the theories emerge from practice, which makes them relevant and suitable for the complexity of reality and they offer the candour for new, unconsidered aspects to emerge.

Part III: Literature Review as Frame Analysis

5. Individual Perspective

The most exciting breakthroughs of the 21st century will not occur because of technology, but because of an expanding concept of what it means to be human.

John Naisbitt

5.1 Introduction and chapter overview

Individuals behave in many different ways when confronted with technological change. Some endorse the new technology and actively pursue it, others are more or less happy to go along with the change and apply the new technology effectively, yet others resist it. This behaviour may be conscious and a function of balanced reasoning or it may be a subconscious process.

In an attempt to understand the individual-centric perspective of those faced with technology changes, the researcher draws from personality and social psychology, sociology, and neuroscience. The multi-disciplinary approach ensures a broad, initial understanding of the different viewpoints concerning individual behaviour, and it offers a chance to broaden consciousness. This approach can then cause conscious decisions to be made about the theoretical knowledge bases which can be used as a foundation for any further investigation. Personality psychology research focuses on three aspects of human beings: individual differences among people, human nature and how all people are similar to one other, and constructs of coherence in an individual (Bradberry 2007). Social psychology researchers seek to understand how thoughts, feelings, and behaviours of individuals are influenced by the actual, imagined, or implied presence of other human beings (Allport 1954, p.5; cited in Fischer and Wiswede 2002, p.9). A sociological perspective helps to interpret social action by providing explanations for subjectively intended meaning (Weber 1922b, p.1), and neuroscience is a relatively new field that explains the biological basis (anatomy, physiology, biochemistry, or molecular biology of nerves and nervous tissue) for behaviour and learning (Merriam-Webster 2008). A deeper understanding of these various fields helps to identify areas of increased sensitivity that can be of significance in technology acceptance behaviour. Eventually, they help reveal new ways of looking at technology acceptance behaviour.

This entire chapter is a theoretical review, assembled in retrospect to reflect the most important findings of this part of the frame analysis. The focus of this chapter

is on the analysis of various possible perspectives regarding behaviour, an explanation of the theoretical choices made, and an investigation of the technology acceptance behaviour. Other issues addressed are the mechanisms of meaning that are expressed in behaviour and the social learning processes involved in acquiring this meaning. Finally, the relationship between social and personal forces will be investigated. Self-processes and various active and central identities are analysed from various theoretical perspectives to make a conscious choice for a suitable conceptualisation that incorporates the various social and personal influences into technology acceptance behaviour. Such a conceptualisation is the mental concept, reframing the research problem of complex and confusing technology acceptance behaviour.

In subsequent steps, this chapter will introduce the breadth of concepts of behaviour, self, identity, and a meaning system approach to develop a conceptualisation of the working self. These details can reveal approaches to gain access to an individual's subjective meaning and reality within a situation of technological change that usually is hidden and inaccessible.

5.2 Understanding the origin of behaviour

5.2.1 Introduction
The human act is the origin of behaviour and this paragraph will look at existing knowledge in more detail in order to further understand relationships of influence in technology acceptance behaviour. Despite the fact that the origin of human behaviour is of great importance to many fields, any discussion is highly controversial due to various underlying philosophical conceptions. This paragraph will sketch out the fundamental differences and justify the choice of a merged social cognitive and social behaviouristic model of the act, as it can be found in a stream of symbolic interaction.

Available theories regarding the origin of human behaviour are divided into three groups, based upon primarily underlying assumptions. First, those who subscribe to behavioural approaches believe the individual is driven by organic wants and needs, and thus instincts and emotions prevail in behaviour (e.g. Freud 1916; 1917). Second, those who subscribe to the functionalist approaches believe behaviour is moulded by the external world, by nature or society (e.g. Day 1977; Skinner 1971, 1974). In both cases, individual thought has no influence on behaviour. The mind and human action do not require any explanation because there is an autonomous biological/natural or social agency. In both cases, there is a straightforward 'stimulus-response-pattern' of the reflex act (Miller et al. 1970, p.6). The third category, however, consists of combined perspectives that acknowledge both personal and situational influences on behaviour. Social behaviouralism (Mead 1973), subjective behaviouralism (Miller et al. 1970), and symbolic interactionism (Stryker 1980) are examples of this category of behavioural theory. Many contemporary behaviour researchers subscribe to some

form of such 'interactive agency', whereby behaviour is a product of the individual's past and present experiences and learning in combination with more mechanistic influences (Bandura 1982; Berger and Luckmann 1966; Bowers 1973; Endler and Magnusson 1975; Erikson 1974; Epstein 2003; Giddens 1991; Keupp 1997; Mead 1934; Pervin and Lewis 1978; Smith-Lovin 2007; Stets and Burke 2000).

This study will base further investigations on interactive models, because purely socially determined behaviour would result in similar technology acceptance behaviour of all individuals within an identical social setting; purely biologically determined behaviour would result in similar behaviour of an individual in a repetitive situation; both patterns do not match repetitively observed, difficult to understand technology acceptance behaviour.

Furthermore, technological advances in neuroscience have added understanding in the field of biological preconditions and experiential learning. According to recent scientific findings, early infant conditioning and ongoing life experiences leave their imprint on each individual, making each brain unlike the other (Spitzer 2002, pp.210-26). From a neuroscientific position, the self is constantly created and recreated however, some mayor dispositions might never change (Goleman 1996; Spitzer 2002). Additionally, there are organic limits to the human act, e.g. a human being will not fly from one's own power. Not all researchers agree that a cognitive-emotional learning organism is the actuator of behaviour. Critiques argue that cognitive processes cannot be clearly described and verified, and thus they remain vague "ghostly inner somethings" (Miller et al. 1970, p.9) that one might accept or not, but that do not offer reliable ways to predict action. They are too complicated to be grasped in theories and models, and thus they are nice to know but they get research nowhere (ibid.).

This study assumes that behaviour is too complex to be captured in a simple theory or model, but knowing about behaviour always precedes understanding it; seeking to understand more about the origin of behaviour in response to technological change as a first step towards understanding underlying mechanisms.

5.2.2 Selected perspectives on the origin of behaviour
Various models of the origin of behaviour, will be contrasted and compared. Each one is grounded in a different knowledge base; common to almost all concepts is an 'interactive agency' between the individual and the context.

5.2.2.1 A sociological model of behaviour: life-world analysis
Looking at behaviour from a sociological perspective, phenomenological life-world analysis matches the understanding of an interactive individual and situational influence. For Husserl (1936; cited in Hitzler and Eberle 2004, p.67) meanings of experiences are determined by acts of consciousness. When experiences are brought together to form a unit, a meaning-relation arises. All subjective meaning-relations together form the individual uniqueness, which then classifies a specific

experience and gives behaviour a specific meaning (ibid., p.68). Meaning is specific to the time when it occurs, to the underlying knowledge and it is marked by typological and relevance structures. For anyone observing the act, the interpretation of meaning can never be more than an approximation, because each person perceives the world in a unique way, and the quality of any interpretation depends on the degree of familiarity with the subjective reality of the actor in that particular moment (ibid., p.69). This suggests that in order for behaviour in a situation to become meaningful, the individual's subjective reality has to be considered, while acknowledging that the shared meaning schemata might be very limited.

5.2.2.2 Psychoanalytic concept of behaviour

One of the earliest and most well known theories is that of Freud (1856-1939), where individuals are merely mechanical creatures, driven by instincts and drives, concealed in the sub-conscious and barely controllable; in a way, individuals are on some sort of autopilot through the various psychosexual stages of development (Dweck 2000, p.136; Pervin 2002, p.271). In further refinements of the original models, emotions still play the most dominant role for individual behaviour and response. Behaviour is guided by an individual's desire to maximise pleasure and to minimise pain. This leads each individual to learn society's dos and don'ts, and to develop a network of defences that helps to ward off anxiety and channel impulses towards socially appropriate behaviour (Dweck 2000, p.136).

5.2.2.3 Social cognitive origin of behaviour

From this perspective, individuals develop personal constructs or schema (Baron et al. 2006, p.42) in order to organise social information and to predict the future; it is a way to perceive, construe and interpret events. An individual aims to act in consistency with its construct system, and anxiety occurs when experiences are outside this construct system or when they seriously threaten to change it (Pervin 2002, p.274).

5.2.2.4 Social-behaviourist origin of behaviour

This perspective assumes interaction between society and the individual in any behaviour. Any meaning in the act is a social product; it emerges on a historical, social and cultural background, which creates a socially shared meaning, used to make sense of behaviour and serving as stimulus for consequent behaviour of others. Any behaviour is a significant symbol, which initiates and to some extend controls the consequent behaviour of others (Morris 1973, pp.18-23).

For Mead (1938, pp.3-25), human behaviour is a cognitive process, with 4 stages: (1) stage of impulse, which is an organic individual response that might get blocked in stage 2 and 3; (2) stage of perception, the definition and analysis of the problem, giving meaning to the situation; (3) stage of manipulation, were action is taken with reference to the individual perception and judgement of the situation; (4) stage of consummation, where any encountered difficulty is resolved and the continuity of

organic existence re-established. Whether or not behaviour is reflective, the blocked impulse requires the reflective process to set up hypotheses in order to guide behaviour. These hypotheses are constructed based on the individual's subjective reality and the consequent meaning given to the situation.

In this process, the individual constructs a relation to the environment through selective perception and through reflective or unconscious manipulation of the objects selected in perception. The path of action is not 'readily there' in the mind of an individual. It is the outcome of the dynamic interrelation of organism and environment (Mead 1973, p.81). Individuals in society create their reality through social behaviour, therefore the individual reality is largely socially constructed and it remains dynamic. The relevant subjective environment is what it is in relation to a sensuous and selective organic individual (ibid., p.218), neither purely rational, nor purely emotional. The cognitive process perceives with two minds, "one that thinks and one that feels" (Goleman 1996, p.8); a cognitive-emotional process.

5.2.2.5 Neuroscience and the origin of behaviour
The discipline of neuroscience explains behaviour by sensory stimuli with impulses and synapses and offers yet another perspective to look at technology acceptance behaviour and its related influences. This brief overview illustrates the basic principles.

Impulse and response
The human brain is a network of 10 million internal connections and more than 4 million nerve fibres as input/output links to the rest of the body (Spitzer 2002, p.54). Sensory receptors receive information through tactile sensations (body senses such as touch, pressure etc.), auditory sensations (hearing), visual sensation (vision), and chemical sensations (taste and olfaction). Through ion channels on the cell membranes, a chain of events is initiated, that produce a nerve impulse (Kolb and Whishaw 2001, p.138), which is chemically transmitted along an axon to the brain (ibid. 130). Within the brain, neurons communicate with each other to pass along information. This takes place through the transmission of the impulse from one neuron to another with the help of synaptic connections (ibid., p.83). Each time, a synaptic connection is used, it changes a little, it learns. Depending on the strength of a synaptic connection, the impulse is strengthened or weakened, individualising the effects of one common impulse between different human individuals (Spitzer 2002, pp.43-4). Synapses vary in structure and location. Dependent on the individual brain structure at a particularly moment, they do one of two things: they excite or inhibit a targeted cell to an individual degree (Kolb and Whishaw 2001, p.163). In order to produce any form of output, motor neurons send nerve impulses to muscles, which results in some form of movement, and movement is behaviour (ibid. 139).

According to neuroscience, the key modulation of any kind of behaviour happens at the synapses: to whom and how strong they communicate will determine the

individual response to an impulse. Some aspects of it are organic, but experience is available through learning and memorising changes in the number and size of sensory synapses and in the number of transmitters in a synaptic connection. They all modify or change the behavioural output (Hebb 1949, p.62; Bailen and Chen 1989; both cited in ibid. p.176).

Learning
In order to learn, two neutrons must fire jointly, which increases the efficiency of the synaptic connection. If multiple firing is experienced, the increased efficiency can last and it functions as memory, thus it provides the structural basis for new behaviour (ibid. p.177, p.184).

Multiple forms of learning are worth differentiating. Habituation is a simple form of learning in which the strength of a response becomes weaker or stronger with repeated presentation of that stimulus. Conversely, there is also sensitisation, were the organism becomes hyper-responsive to a stimulus, rather than being accustomed to it (ibid., p.179). The size and number of synapses decrease in habituated individuals and increase in sensitised ones (ibid, p.185). One can conclude that   individual behavioural changes depending on an individual's biography of experience and learning, and this influence is more or less cognitive, dependent on the form of learning and experience.

Hierarchical control of behaviour or how emotions overwrite choice
The process of behaviour is hierarchically organised. The brain tells the hand to reach, and the hand tells the brain that it succeeded (ibid., p.356). However, there are immediate responses of the body, where there is no brain involved. Many reflexes are organised at the level of the spinal cord and occur without any involvement of the brain. Emotions can be characterised as an automatic reaction of the organism, etched in our nervous system. Thus, an emotional reaction can sabotage thinking despite any intellectual potential (Goleman 1996, pp.24-6). For a long period in human history, these direct and, therefore, fast emotions made the difference between survival and death (ibid., p.5). While they have become less important in the last 500 years, the interest for survival is deeply etched in human brains, and modern individuals are confronting 21st century dilemmas with an emotional repertoire "tailored to the urgencies of the Pleistocene" (ibid.).

Importantly, there is an individual difference in how a brain is wired, how fast the amygdale reacts, which directly relates to how emotional the individual reacts (Goleman 1996, pp.27-8; Spitzer 2003, pp.157-9), and how fast and intensive the rational thought processes are started. These organic differences are significant factors for individual behaviour.

Additionally, individual reaction also depends on the individual wiring of the prefrontal cortex. The right prefrontal lobe hosts negative feelings like fear and aggression while the left frontal lobe regulates them. All the prefrontal-limbic connections are essential in the navigation through the decisions for behaviour

individuals take, and explain a bandwidth of reactions triggered through identical cause.

5.2.2.6 Considerations and reflections on human behaviour

Each one of the described models of human behaviour has profound focal perspectives. From a social cognitive perspective, behaviour is a cognitive process, acquired through experience and learning and with a great emphasis on change, whereas no great attention is paid to affective and unconscious action. In contrast, the psychoanalytical perspective almost entirely emphasises affect and to some degree early infant experiences. From a phenomenological perspective, weight is given to the unique way an individual perceives the world, however the potential for change is not particularly emphasised and affective action is addressed only in its relation to the individual perception.

In contrast, social cognitive, social behaviouristic models as well as the neuroscientific perspective argue in favour of a multi-layered interaction between the organic individual, its social learning history and the immediate situation. Human behaviour is driven by a predetermined, individual organic structure as the basic structure that limits action. This structure is individualised through past learning experiences, and through the cognitive-emotional interpretation of the immediate situation. Together this results in an individually unique, but possibly akin response to a maybe very generic stimulus. Since an individual brain's wiring does not usually change at a fast pace, past patterns of behaviour are likely to give an indication for future behaviour. Conceptualising behaviour based on the described theories, they all recognize the importance of experience, impulse and affective action. Furthermore, they recognise a degree of cognition, ongoing experience and the immediate situation. While they differ in the weighting of these influences, behaviour grows out of these conditions in unison.

Despite the different knowledge bases, all three concepts interact with society, in order to give action a meaning. They all define a social process that gives an organic individual a 'mind'. This mind, also called 'meaning system' is the product of a distinct and individual learning history. Furthermore, particular to the social cognitive, the social behaviourist and the neuroscience perspective is the dynamic of this subjective reality. They argue for the development of a meaning system that is formed by experience, but that remains capable to learn and change. The discovered dualism of personal and social influence on individual behaviour raises the question as to which exercises what influence. A closer look into the individual and his or her 'self' will uncover more details. A second set of questions centre around the socially learned knowledge and experience: where does it go?

The phenomena associated with an individual meaning system, which is said to be embedded in the concept of 'self' and 'identity' are manifold and confusing, and the used terminology is far from unitary. The following paragraphs will discuss some of these concepts in order to increase understanding, and to construe a

relationship between them that helps shed light on the complex processes engaged in technology acceptance behaviour.

5.3 An individual's meaning system

Individuals have a system of beliefs with which they create meanings. This system of beliefs is called a 'meaning system'. The following paragraph will outline a symbolic interactionist's meaning system approach as it is used in this study.

Most complex human behaviour involves some degree of self-reflection, as the previous paragraphs have shown. This self-reflection is guided and aided by meaning that is accumulated through past and present learning and that forms a "meaning system" [2] (Mischel and Morf 2003, p.29). This meaning system describes the world and can be stated in terms of a highly organized, coherent system of mental-emotional representations (ibid., pp.16, 23). These "constructs" (Kelly 1991), or 'translation programs' act as a form of filter in order to make sense of the world and the individuals within it. A meaning system comprises individual beliefs, values, goals, needs, and ethics. Figure 15 symbolises such a meaning system.

Having 'meaning representations' available for categories of stimuli serves a purpose. It allows for semi-automated reactions, enabling rapid response (Chen and Bargh 1999; cited in Baron et al.2006, p.133); it permits the expression of central values and beliefs as an expression of 'who one is', which is a self-verifying identity function; and it maintains or enhances self-worth (ibid., pp.134-5).

A meaning system is an intangible construct and a core part of an individual's self. Sometimes, the terms 'self' and 'meaning system' are used as substitutes for one another so it is difficult to define the boundaries. In this study, the meaning system is defined as a core part of an individual's 'self', the self incorporates additional self-processes, that are explained in the course of this chapter.

Characteristics of a meaning system, as defined in this study, have a direct influence on the characteristics of the self because they are close to what personal psychology often calls 'personality'. That is, some meanings portray a dynamic self and a dynamic world, capable of growth and change, while other beliefs are rather static and fixed, reflecting a simpler world that is more easily understood (Dweck 2000, p.132). These meanings can be described as individually different, yet relatively stable tendencies that individuals bring into a situation. New experiences can modify these tendencies because the individual can learn. The following paragraphs will outline such social influences which result in learning in more detail.

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[2] Earlier authors called it "psyche" (Aristotle; cited in Kolb and Wishaw 2001, p.9) or "mind" (Mead 1934, p.131)
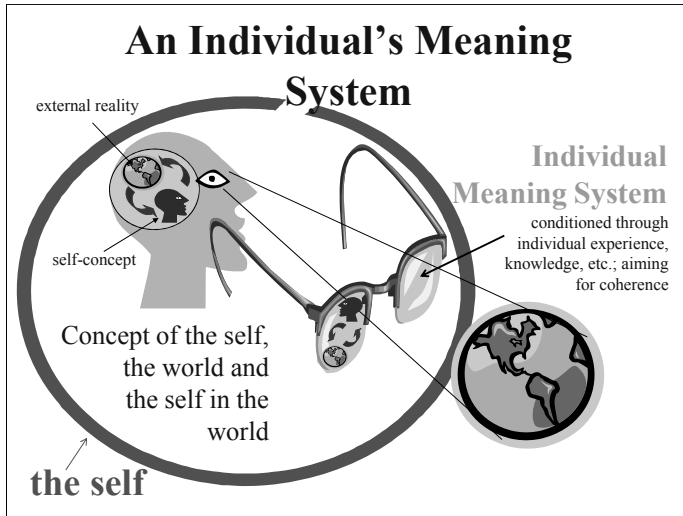
Figure 15: An individual's meaning system

5.4 The concept of self and identity

In retrospect, the self and its active and central identities have been found to be key constructs to further understand an individual's meaning inherent in an action. Furthermore, they determine the final unique balance between individualistic forces and various social forces that influence behaviour.

In the perspective selected for this research study, the self and its identities are products of an individual's meaning system, but there are many different positions and conceptionalisations on the self and identities. This section introduces a variety of understandings and argues for the perspectives chosen.

5.4.1 The breath of meaning inherent in self and identity

The self and identity are terms that seem hard to grasp, because these concepts have been studied in many different ways. Additionally, both terms carry meaning in everyday language, and one is never quite sure for which one of its many meanings the term was used. Some studies do not explicitly differentiate between the terms 'self' and 'identity' (e.g. Aronson et al. 2005, Cast 2003, Erikson 1974, Mead 1934). Other authors seem to use the term 'self' referring to a person's self-concept (e.g. Epstein 1979). In personal psychology, the term 'personality' seems to refer to some degree to what is called 'self' in this study (e.g. Rotter 1982). In other studies, 'identity' is conceptualised as a core element of the 'self'. It is the mediating element between internal and external world, and an individual has multiple identities that are all part of the 'self' (e.g. Baron et al. 2006; Fischer and Wiswede

2002, Stets and Burke 2003); a conceptualisation that other scholars refer to as 'working selves' (Mischel and Morf 2003).

5.4.2 Conceptualising the self

Leary and Tangney (2003, pp.6-8) identified five distinct and disparate ways in which behavioural and social scientists use the term 'self' today: First, it is used synonymously with the total person, which does not capture any scientific precise standpoint, and must thus be neglected for this work. Secondly, there is the self as an experiencing subject, an active processor of knowledge; as the person that gives answers to the question "Who am I really?" and "How do others perceive me?" This position can be compounded with the metaphor as a reader and writer of the book of 'self', who at any point in time can access a chapter and read it, or add a new chapter by writing one (Aronson 1999; cited in Aronson et al. 2005, p.132). This concept goes back to the self-as-subject (the 'I') (Mead 1934, p.175). Constructs that are more recent define it as self-awareness, which is the act of thinking about oneself and the act of self-monitoring, an act, which is concerned with the public-self, the socially apparent self as it is perceived by others (Scheier and Carver 1983, p.126). Another use of 'self' is the self as an object, as the known. This 'me' can be seen in contrast to the 'I'. Using the book metaphor again, while the 'I' is the reader and writer of the book, the 'me' is the book itself, the content which contains the beliefs about oneself, the cognition, perceptions, thoughts, and feelings about oneself, all the answers that a person gives to the question 'Who am I?' and 'What am I like?'. It is an individual's self-concept. Recent discussions about a fragmented self vs. a coherent self all belong to this use model of the self. An individual's perceptions and beliefs about oneself are a core element of the self. Terms like self-concept, self-image, self-schema, self-beliefs, all belong to this category of self. Next, there is the self as an executive function: a decision maker and doer that regulates behaviour. The personality structure represents the core of decision-making, planning and defensiveness (Hamacheck, 1971, p.6; cited in ibid.), an individual's deliberate effort to regulate own behaviour often referred to as self-control and self-regulation. Lastly, there is the 'self' as personality. Some writers use 'self' to refer to all or part of an individual's personality. The self is equated with behavioural potentials (Wicklund and Eckert 1992; cited in ibid.); a collection of abilities, temperaments, goals, values and preferences that distinguish one individual from another. While some argue against this usage, claiming that the totality of aspects get far better represented by the term 'personality' (Leary and Tagney 2003), others disagree and distinguish between two traditions of personality psychology. In one tradition, personalities are essentially stable traits that do not change and that distinguish different personality types However, there is a second conceptualisation of personality that rejects the "trait-equals-personality equation" (Mischel and Morf 2003, p.21). Here, personality is construed as a system of mediating mental processes and structures in the conscious and unconscious, featuring cognition, affect and conation (Huitt 1996; cited in Huitt 1999), some even add consciousness (Mayer et al. 2000, p.98).

The focus is on how and why people think and feel as they do, and on their interactions with the social world, personality is seen as a cognitive-affective system throughout the life-cycle (e.g. Mischel and Shoda 1995; Shoda, LeeTiernan and Mischel 2002).

Research about the self and research about personality processes represent two different traditions of psychological theory, but they ask closely related questions. According to Mischel and Morf (2003, p.22), both sides benefit from an integration of understandings. Following this recommendation, understanding about a dynamic personality will be merged with the understanding concerning an individual's meaning system.

As a consequence of this information, this frame analysis will look for a conceptualisation of self, personality and identity that takes into account the latest efforts and attempts to merge and unify the confusing range of understandings (Abdelal et al. 2001, 2007; Stets and Burke 2000; 2003). Furthermore, it will attempt to be precise in the determination of meanings to not carry on the semantic confusion. In order to not carry on the semantic confusion and to discover a conceptualisation of self that will aid the research, the historic foundation of today's most commonly used concepts of self will be discussed.

5.4.3 History of self and a selection of classic concepts

In many theories of psychology, the self was and still is playing a central role in motivation, personality, and development. The various philosophical perceptions that distinguished understandings concerning the human act are present in the theories of the self. Some of the most significant classic and contemporary concepts will be analysed.

5.4.3.1 History of self

Eastern writers have been wrestling with the self and reflexive consciousness as early as 600 BC, such as in the "Upanishads" in India, the Tao te Ching in China or in the philosophy of Gautama Buddha, western philosophy of the self can be found in Plato (Leary and Tangney 2003, p.4.). Over the following 2000 years, most western discussion of the self can be found in religious motivated writings, condemning the evils of self-centeredness such as egoism or pride, giving spiritual insight how to escape what was seen as immoral behaviour (ibid.). With renaissance thinking, a consciousness for the tendency to self-deception developed, making the concept of a 'self' necessary (Baumeister 1999; cited in Fischer and Wiswede 2002, p.351). Each theory that emerged thereafter developed its own ways of how individuals forge their selves and identities, but they all have the common denominator that unlike most animals, humans develop representations or ideas about themselves that have significant motivational power (see e.g. Dweck 1999, p.138; Scheier and Carver 1983, p.124).

5.4.3.2 Dualistic concepts of self

James

The concept of 'self' was introduced by the American psychologist William James (1890) at the end of the 19th century. At its core was a duality of perception, the first of which is composed of the thoughts and beliefs an individual has about itself; the 'known' or the 'me', also sometimes referred to as the 'social self', however, the self is also the active processor of information, the 'knower', the 'I' or the 'individual self'. In modern terms, the 'me' is the self-concept, the content of the self. The act of thinking about oneself, the 'I', is what is usually called self-awareness (ibid.). The combination of the two aspects of the self create a coherent sense of identity (Fischer and Wiswede 2002, p.353).

Mead

Following James's research, Mead (1863-1931) distinguished between extrinsic and intrinsic sources of influence on the self. He described a social and an individual self. The social self combines the socially influenced aspects of the self in contrast to the individual self, that represents the unique and creative individual self (1934, pp.175-85). For Mead, the individual self acts and behaves within the context of the social self (ibid., p.223). This social self represents collective values and these socially defined values can under extreme moral conditions call out the sacrifice of the individual self for the whole (ibid., p.214). Thus, the self is a product of social interaction but the individual's response to the social world is active: the individual decides what to do in the light of the attitudes of others (ibid., p.175). This perspective has regained academic acceptance in contemporary self-concepts especially but not exclusively in concepts of symbolic interactionism (see e.g. Aronson 1999; Bandura 1986; Epstein 2003; Pervin 2002; Smith-Lovin 2003; Stets and Burke 2000; 2003; Stryker 1980; Stryker and Burke 2000).

Rotter

Based on a similar understanding is Julian Rotter's definition of personality. The main idea in Rotter's (1916-1985) social learning theory is that personality represents an interaction of the individual with his or her environment. There is no personality independent of the environment (Fischer and Wiswede 2002, pp.74-5); neither is there an automated response to an objective set of environmental stimuli. To understand behaviour, one must take both the individual (i.e. life history of learning and experiences) and the environment (i.e., those stimuli that the person is aware of and responding to) into account. Rotter describes personality as a relatively stable set of potentials for responding to situations in a particular way. He does not believe in a critical period after which personality is set, rather, with increased life experience certain sets of beliefs get manifested and more effort and intervention is required to change personality. Generalised expectations develop through experiences and can develop into personality dispositions.

Rogers

Attempting to understand how individuals view themselves and the world around them, Carl Rogers (1902-1987) emphasised the self as a part of personality, where conscious and unconscious perceptions make up an individual's phenomenal field (1951; cited in Pervin 2002, p.269). The self-concept represents an organised and consistent pattern of perceptions that does influence behaviour, it reflects experience and it influences it. In addition to the self, an individual has an ideal self, which represents the self-concept an individual would like to possess most (ibid.). Rogers identified a need for self-consistency that is the congruence between the self and experience in order to maintain a sense of self, but he also emphasised the need for self-worth; a conflict, which is present in many contemporary concepts. For Rogers, the need to maintain a positive image wins over the need to maintain a consistent image in order to maintain a satisfying self. Critiques of Roger's concept of self point out that the self seems to take on a life of its own, distinct from the whole person (Mischel and Morf 2003, p.17).

5.4.3.3 A personal construct concept of the self

Kelly

Kelly (1905-1967) developed a theory of personal constructs, where individuals observe events and formulate constructs to organize phenomena and to predict the future. Each individual develops an individual set of constructs, which he or she uses to make sense of the world and the people in it. "Man looks at his world through transparent templates which he creates and then attempts to fit over the realities of which the world is composed" (Kelly 1991, p.7). He concludes that individuals are different from each other, because they have different templates or constructs to anticipate a situation; each has a different constructed way of perceiving, construing or interpreting events. Constructs are organised in a system with a certain hierarchy of core and subordinate constructs (Kelly 1991, pp.82-3). The self can be seen as a construct or it can be seen as an individual in a role to which the construct is applied. Especially interesting is the construct theory in predicting events. Consistency within the construct system permits predictions to be made. When the system cannot provide a prediction, or when the experienced events are outside the construct system (ibid., p.38) anxiety prevails. An inconsistent construct system creates contradicting predictions, threatens the construct system itself and comprehensive change in the construct system might follow. Consequently, people are motivated to preserve the consistency and integrity of their self-theory. Notably, not all parts of the construct system are conscious.

5.4.3.4 A psychoanalytic concept of the self

Freud

As already mentioned in the context of the human act, Freud's (1856-1939) psychoanalysis emphasises the importance of pleasure and pain as the most

important motivators in individuals' lives, a concept that does not offer any growth potential outside these two dimensions, and that has no place for the establishment, validation or expansion of a self. The "ego" sometimes is confused with "self" or identity, but Freud's main emphasis remained on drive-instincts and conflicts between reality and the superego (Parvin 2003, p.271). It is this concept of the super-ego or executive ego that seems to have left its marks in the theories of self. The executive process, monitoring and controlling the self, as well as self-evaluative processes have here their origins (Mischel 1998; cited in Mischel an Morf 2003, p.17).

5.4.3.5 Growth oriented self-theories

These theories assume a linear finality from a less developed to a more developed condition. There are periods of time during which the organism can be described in terms of specific characteristics; different stages are associated with different developments or changes. These theories assume an end of development of particular aspects of the self, and they define critical periods for development. Erikson, Jung, and Maslow, but also to some extent Freud and Piaget (Fischer and Wiswede 2002, p.351) can be seen in this light.

Growth oriented theories of the self, focus on progress and achievements. They dominated personal psychology in high modernity. The concept of Jung and the often-applied model of Erikson will get exemplary attention.

Jung

According to Carl Jung (1875 -1961) the self is a totality, consisting of conscious and unconscious contents that dwarf the ego in scope and intensity. The maturation of the self is a process of individualization, with a quest for growth and self-development at its heart. He categorized human individuality into "psychological types" by attitude types (extroverted - introverted) and four functions of the mind: thinking, feeling, sensation, and intuition; one or more of which predominate in any given person (Jung 1923).

Jung described the extravert person: "his entire consciousness looks outwards to the world, because the important and decisive determination always comes to him from without. But it comes to him from without, only because that is where he expects it." (Jung 1921, approx. p.3). All distinguishing characteristics of this individual have their origin in this basic attitude, and any action is governed by the influence of other persons and things. One's own subjective realities coincide with social reality (ibid.). In contrast, the introvert "interposes a subjective view between the perceptions of the object and his own action" (Jung 1921, approx. p.22). While introverted consciousness views the external conditions, it selects the subjective determinants as the decisive ones. For the introvert, it is perception and cognition that guides action rather than normative structure.

Jung's classification of individuals is still used today as evidenced in the Myers-Briggs Type Indicator (MBTI), which is an example of a widely used psychological

self-report instrument based on Jung (Myers 1962; cited in Kolb 1984, p.80). In that respect, Jung was the first to successfully categorise unique individuals in attitude types.

Erikson

Erikson's genesis of identity[3] (1973; 1974) was most commonly used at the heights of modernity. In accordance with James' and Mead's thinking, identity develops reciprocity between individuals and society. It is characterised by a continuous effort to be oneself while remaining a part of a larger group (Erikson 1973, pp.124-5). He describes eight phases of the development of the self. Phase 1-4 are phases in childhood that are responsible in the infant age for the development of basic trust, as a prerequisite for any social cooperation. Soon after, the basic conditions of self-respect and uncertainty develop. Volition and initiative are acquired during kindergarten age. Diligence or a feeling of inferiority develops during school age. Adolescence is the time where the individual self and an ego-identity develop. Started by cumulated contradictions, the young individual enters an identity crisis that leads to a search for oneself (moratorium) (ibid, p.146). If all went well, the various ideas of oneself, and the roles entered during childhood, slowly merge into one balanced whole, the centre of an existence, a core identity (Turkle 1995, p.203). If the integration of various roles and self-concepts do not merge well, one speaks of identity-diffusion or -confusion. Such a person is characterised as being immature, and chronically restless and helpless. The development of an individual self is a prerequisite in order to later reflect on the self and to experience empathy. Early adulthood then becomes the time when the newly acquired identity is tested in everyday life. The identity becomes integrated into social life and the I-identity becomes validated. If this process works as it should, the need and willingness 'to give' prevails. Those individuals that are not able to care for others use this energy to care for themselves (Erikson 1973, p.117). In old age, life gains importance through the reflection on one's own biography, and by maintaining mindful and active work; it becomes important to accept the limitations of human life and to understand oneself as part of a larger whole, which includes former generations (ibid., p.118). This last development phase leads to integrity (with desolation at the other extreme).

For Erikson, identity seems to be an individual's subjective sense of alikeness and continuity, together with the belief in the alikeness and continuity in some shared world images (Burke 2003, p.1).

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[3] Erikson uses the term identity to some extend as this study uses the term self. Since he does assume a stable identity, once it went through its stages, his identity also suits to some degree with what later will get defined as identity for this work. For this reason, the term "identity" did not get replaced in this description, but was kept as used by the author.

5.4.3.6 Reflections on some classic concepts of the self

Contemporary concepts often consider merged aspects of some of the following positions, along with some new considerations.

Dualistic approaches (James, Mead, Rotter, Rogers) take full account of an individual's experiences in a normative world, acknowledging the relationship between society and the self, while they allow for aspects of personality that are independent of society and the situation. They explain seemingly contradictory behaviour of individuals in different social situations, when e.g. a very caring father and partner is a rather ruthless manager and employer. In all dual concepts, the self is shaped by past and current social macro and micro contexts.

Kelly's 'personal construct concept' offers a typology approach to shared meanings. Typologies usually simplify a complex construct, which means details sometimes are ignored; however, it allows a cut through to an underlying essence that helps understanding. They might oversimplify, but patterns are likely to emerge that aid deeper understanding of underlying conscious or subconscious factors that influence behaviour.

Growth oriented theories (Erikson, Jung) claim that most of the self and identity develops in a set timeframe and sequence. This also means that once a development phase is over, these aspects of the self and of identity no longer change. However, there is evidence for stability-continuity and for change, and that the level of stability observed may depend on the personality characteristics measured (intelligence, temperament vs. attitudes etc.) (Pervin, pp.216-7). Under these considerations, stage theories seem to fall short in explaining some of the phenomena involved. Many contemporary concepts acknowledge a development preference at a certain age, but they deny fixed stages. Recent longitudinal studies e.g. offer evidence that personality is more stable during adulthood than during childhood (Costa and McCrae 1994; Roberts, Caspi 2001; Roberts and Del Vecchio 2000; cited in Pervin 2002, p.214).

5.5 The perspective of symbolic interactionism

This study may deepen an understanding of the influences of society and the individual on technology behaviour. Consequently, the focus has to be on all possible social and individualistic influences. So far, this frame analysis revealed behaviour as a product of past and present multi-layered interaction between the organic individual, its social learning history and the immediate situation. Complex social behaviour is usually cognitive or cognitive-emotional behaviour. In order to understand the underlying cognition, an individuals' meaning system must be disassembled. A meaning system is a dynamic system. Some early and repetitive social learning leads to behavioural patterns that are persistent, but most behaviour is guided by experience and learning that can be dynamically modified through new experience and learning, thereby modifying an individual's meaning system. Furthermore, a meaning system is a social product; meaning emerges based on a

shared historical and cultural background as well as on an individual's biography. The shared background accounts for socially shared meaning, a social reality; the individual biography accounts for individualistic interpretations.

Shared meaning, which leads to unified behaviour among different individuals, can be cognitive-emotional or automated. In the latter case, it has been internalised and no longer requires cognition. Institutional conditioning occurs through the internalisation of social values, and norms into ones self-concept. Last, individually different meaning can originate from an individual's unique knowledge and experience, or from an organically unique constitution. This leads to what Mead describes as:

> *What is accessible only to that individual, what takes place only in the field of his [or her] own inner life, must be stated in its relationship to the situation within which it takes place. One individual has one experience and another has another experience, and both are stated in terms of their biographies; but there is in addition that which is common to the experience of all.*   *Mead 1934, p.33*

5.5.1 Structured symbolic interactionism

Structured symbolic interactionism is a perspective from sociology and social psychology that combines common behavioural patterns with individualistic ones, that acknowledges stable, durable elements of personality with dynamic aspects. The ontological and epistemological positions are covered in the methodology. For symbolic interactionists, society shapes the self, which then shapes social behaviour (Smith-Lovin 2003, p.167), just as individual behaviour becomes a unique characteristic of the self, thereby enforcing or modifying the existing social order (Thoits 2003, p.179). Consequently, to understand an individual's behaviour one has to understand the self and its related self-processes. Furthermore, the self emerges and changes in social interaction, thus one has to understand the individual in order to understand the situation just as one has to understand the social situation to understand the individual (Shoda 2004, p.117). Inherited from Mead (1934), the self emerges out of the meaning system; the meaning system develops out of social interaction. Stryker suggests,

> *Behaviour is premised on a named or classified world. The names or class terms attached to aspects of the environment, both physical and social, carry meaning in the form of shared behavioural expectations that grow out of social interaction. From interaction with others, one learns how to classify objects one comes into contact with, and in that process also learns how one is expected to behave with reference to those objects.*   *Stryker 1980, pp.53-4*

Additionally, there is shared behaviour by internalisations or expectations, where

> *...learned in interaction, are the symbols that are used to designate*
> *positions, which are relatively stable, morphological components of*
> *social structure. These "positions" carry the shared behavioural*
> *expectations that are conventionally labeled "roles".*   *ibid. p.54*

Critics point out that emotions and some aspects of motivation remain unclear in symbolic interactionism (Westen 1992; cited in Pervin 2002, p.283). The upcoming discussion of emotional processes will address this issue. Furthermore, a symbolic interactionist's perspective is in harmony with some contemporary models of personality (see e.g. Huitt 1996; Tallon, 1997; cited at Huitt 1999; Mayer et al. 2000, p.100), where mental maps and dominant mental traits define the self. A separate paragraph at the end of this chapter will address this fit by using a neuronal network model as a functional model of the self-system. Symbolic interactionism seems to be a promising perspective for further investigations into technology acceptance behaviour.

5.5.2 Processes of a self-system

To further understand the mental system that is called 'self', some of the interdependent self-processes, the attention process, the cognition process, the emotional process and the regulation process will be examined from a social interactionist perspective. These processes introduce the self-concept, self-awareness, self-esteem and self-respect as well as self-control.

5.5.2.1 Attentional processes

Self-attention or self-awareness is the act of thinking about oneself (Aronson et al. 2005, p.132), or speaking in the metaphor used earlier: it is the act of reading the book. When people focus attention on themselves, when they introspect and examine their own thoughts, feelings and motives, they evaluate and compare their behaviour to their internal standards (ibid., p.139). This has effects on thought, emotion and behaviour because self-awareness intensifies and updates the self; it is the starting point for most self-related processes (Leary and Tangney 2003, p.9).

Not all self-awareness is the same. Considering the situation, one can identify a distinction between private and public self-awareness. Public self-awareness increases in a situation, where one knows that others are watching, and were motives such as self-presentation or self-portrayal become important (Scheier and Carver 1983, p.126). In a situation of high public self-awareness, individuals are more willing to conform to the expectations of others (ibid. 1981; cited in Fischer and Wiswede 2002, p.359). Furthermore, individuals seem to vary in their willingness to think about themselves. Common patterns indicate that self-attention is avoided when it is expected to have negative consequences for an individual's self-esteem (ibid.). One consequence of high self-attention is the increased influence of own values and beliefs on one's behaviour, furthermore, own emotions are intensified (Gibbons; cited in ibid.). Both points lead to a frequently updated and intensified self.

5.5.2.2 Cognitive-emotional processes and self-concept

Cognitive processes and self-concept
The self-process allows people to think consciously about themselves, and it allows them to be "reflexive" (Giddens 1991, p.77; Leary and Tangney 2003, p.8). Such self-thoughts can centre on one's current state and situation, one's enduring attributes and roles, memories, imaginings or any combination.

Cognitive processes concerning the self require the construction of a self-concept, in social psychology also called 'identity', which is the intrinsic knowledge about who one is. It is the book that holds the thoughts and beliefs about oneself, the content of the self, the 'me' (Mead 1934, p.174), or, as some scholars put it, it contains the sum of judgements or the various partial judgements of an individual about itself (Epstein 1979). The self-concept has an organisational function, which helps to interpret and recall information about oneself and the social world (Aronson et al. 1999, p.132). It can be seen as mental framework individuals use to organise their knowledge about the social world (ibid., p.59).

The self-concept or identity is one of the most important concepts of an individual, and its positive or negative evaluation is an individual's self-assessment (e.g. it is good that I am friendly). Together with aspects of an individual's self-efficacy, they result in an individual's self-esteem and self-respect, one's overall attitude towards the self (Baron et al. 2006, p.184). Self-esteem can be used as a measure of how well an individual can accept itself, how it values its contribution to its environment, and how it judges its self-efficacy (Fischer and Wiswede 2002, p.356). "An individual develops a preferred theory of the self while it acquires strategies for dealing with different types of interpersonal situations during the life course" (Mischel and Morf 2003, pp.29-30). The self as a whole is validated and tested over times, where it becomes increasingly elaborate and complex. Self-theories are not highly conscious; they remain largely implicit with some explicit expressions.

Self-evaluation
Self-evaluation is the evaluative part of the self-concept, often called self-esteem and self-respect (Stets and Burke 2003, p.131). It is a valued good for an individual's self-concept, and individuals attempt to protect it under thread (Baron et al. 2006, pp.174-83), which can be a significant motivator for behaviour. Two dimensions of self-esteem are usually differentiated: there is efficacy-based self-esteem, were efficacy is the belief about one's capabilities and competences (Bandura 1982, p.3), and there is the worth based self-esteem, which gives the feeling that one is accepted and valued (Gecas and Schwalbe 1983; cited in ibid.) This is also called outer self-esteem vs. inner self-esteem (Franks and Moralla 1976; cited in ibid.).

Emotional processes

So far, the emphasis of behaviour has been on cognition. However, emotions are also indispensable to behaviour. When there is an infinite array of choices, emotions help streamline decision by eliminating large ranges of alternatives, and by highlighting some options. Thus, emotions are crucial for effective thought and for making wise decisions (Damasio 1994; cited in Goleman 1996, pp.27-8). Feelings point in the right direction, where logic can then be of best use. As Goleman puts it "we have two brains, two minds - and two different kinds of intelligence: rational and emotional." (ibid. pp.28,53). Research suggests that both processes determine decisions made in life, but it is important to keep in mind that strong feelings can get in the way of rational reasoning, just as the lack of awareness of feelings can be ruinous (ibid., p.53). The stimuli for emotions is usually not factual, but cognitive (Epstein 1979): fear appears when one sees a snake that is consider toxic, whereas there might not be any fear when interpretation leads to the conclusion that the snake cannot do any harm. However, in reality, the first one might be harmless and the second deadly. Other examples are that an individual is annoyed when thinking one was wronged; sadness might attune if one worries about losing something. These are all examples that indicate that it is not the facts that trigger emotions; it is the individual's interpretation of the reality (Dweck 1999, p.139; Epstein 1979, pp.22-3; Mischel and Morf 2003, pp.27-8). The cognitive meaning that is given to situations provoke the emotional process, thus important emotions are closely tied into cognition. Consequently, it seems appropriate to enlarge what Leary and Tangney define as "cognitive process" (2003, p.9) into a 'cognitive-emotional process'.

Executive processes

The ability to attend and think about oneself in an immediate or future situation offers the opportunity to regulate behaviour in accordance to one's own understanding of how one should behave. It is a regulation and control opportunity for individuals' choice of thoughts, feelings and behaviour.

It is understood that

> *... peoples' efforts at self-control are met with mixed success, but the possession of a self at least allows the possibility that one can occasionally escape the influence of one's environment, history, and internal state to act in autonomous, self-directed ways.*
>
> *Leary and Tangney 2003, p.9*

Given the mixed success of self-control, the question is how people make what they consider 'optimal choices', and how they behave in what they see as 'optimal ways'. One approach in understanding self-control processes is the self-regulatory resource model, that suggests that self-control is a limited resource that gets tired when used extensively, or when an individual is tired or under stress, but it re-

bounces, as soon as there was enough recreation time (Baumeister et al. 2000; cited in Aronson 1999).

Another explanation is offered by self-regulation as part of a behavioural model of reciprocal determinism. Self-regulation takes 3 steps: (1) self-observation, which means to monitor one's own behaviour; (2) judgement, where one compares one's own behaviour with internal standards; (3) one's self-response: if one did well in comparison, one gives rewarding self-response, if one did poorly, self-responses are punishing. Over the years, this mechanism of social learning (which means setting and modifying the standards) and self-regulation (using the standards and judging one's performance) will lead to a pleasant or not so pleasant self-concept, followed by a high or low self-esteem (Bandura 1982, pp.3-22). An ongoing cybernetic loop in the processes of the self.

Yet another perspective on the executive processes can be seen when considering the individual's reflexive thought as socially determined. The internalisation of a certain morality and culture make the individual a moral individual and society can exercise influence through the mechanisms of a common reality (Mead 1934, pp.386-7). Such an internalised morality is a central element of society to exercise power over its members. The societal perspective of this work will investigate the mechanisms in more detail.

Each one of these self-control theories is built on an individual's ability to attend to oneself and to think about oneself, at least to a certain degree. What remains controversial is the sources of reflexivity beyond the conformity with a social, moral cause. While attention, cognitive-emotional and executive self-processes serve a distinct function, they remain closely related and cannot stand by themselves. They determine each other and in their integration, they form the individual self.

5.6 Identities: self-concepts in recurrent situations

5.6.1 Introduction to identity
Identity has been introduced as an individual's self-concept in a particular situation (Mead 1934, , p.174). More precisely, it is defined as self-concepts in recurrent situations (Leary and Tangney 2003, p.9) in this research study. However, the meaning of the term 'identity' varies between the disciplines. For sociology, identity relates primarily to role and group behaviour (Stets and Burke 2000), while psychologist like to refer to identity as 'the unique individual' (Fearon 1999).

In order to avoid semantic confusion, this study will use Fearon's (1999) term 'social-identities' as an umbrella term, capturing all identities that hold a commonly understood meaning. Social-identities answer the question 'who are you?' and can be split into a collective and a relational type: group- and role-identities (ibid., p.11). In contrast to an individual's social identities, each individual further holds a unique 'personal identity' of physical and psychological characteristics (ibid. p.20;

Thoits 2003, p.181). Self-processes create identities in order to mediate between the individual and the actual situation (Epstein 1976, p.16; Haußer 1995, pp.7-8; Keupp et al. 1999, p.28). They are self-concepts for particular recurrent life situations, where they provide standards of what one should do or be (Higgins 1987; cited in Leary and Tangney 2003, p.9). These 'ready-to-use' sets of meaning release the reflexive self of ongoing choices. Their activation is not a conscious act; rather it is an automatic mechanism, dependent on the features of a situation.

5.6.2 Types of Identities

Three major streams of identity studies can be distinguished in symbolic interactionism. The first is 'social identity theory', which is concerned with the groups and categories a person belongs to; second is 'identity theory', a line of thinking that is primarily concerned with the roles played within a society, a perspective more common in psychology. Both streams categorise identities and the identity content, which is commonly shared within a society. In contrast to these shared identities, there is personal identity, which is closely related to personality and which usually comprises a set of attributes, beliefs, desires and principles. It is a source for self-respect and dignity (Fearon 1999, pp.2, 11) and close to the individual self.

5.6.3 Social identities

Social identity in the sense of either group or role-identity is the social answer to the question 'who are you?'. Importantly, this question will be answered differently in different situations. At work an individual might answer 'I am a mechanical designer', or 'I am the project leader' while in a private setting, the answer might be 'I am the father of Steve', 'I am a good runner', or when travelling internationally 'I am German'.

'I am a mechanical designer' can be the answer to express that one qualifies as a member of a group of mechanical designers, and the answer expresses that one shares similarities with them, such as e.g. an in depth understanding of stress analysis. Here, the answer expresses a group identity. However, the same answer can be expressed differently. 'I am a mechanical designer, in contrast to the electrical designer who will get my construction, once I am finished with the mechanical machine design'; in this sense, it expresses how one is different from the rest, and thus points to a role identity. Both kinds of social-identities will be investigated.

5.6.3.1 Group Identity

'Group identity' is a collective term in which identity represents the norms, values, beliefs, goals, morality and practices of a group or collective. Group-identity has been studied intensively in what is called "social identity research" (Turner et al. 1987; Tajfel 1981; all cited in Stets and Burke 2000, p.9). A large part of this stream of research is concerned with social-identity in the context of nations and ethnicity (see for example Calhoun 1994; Baumann 1999; pp.9-36; Holland, et al.

1998; Lash and Featherstone 2002). This is not the focus of this study; consequently, this stream of knowledge, although important, will be ignored in this study.

Group identity theory has been defined by Stryker (1980) and deals with intergroup and intragroup relations, investigating how people come to see themselves as members of one group or category (the in-group) in comparison with others (the out-group), and with the consequences of this categorisation. Having a particular social-identity means to be at one with a certain group or category, acting like others in that group and seeing things from the group's perspective; a uniformity of perception and thus a uniformity of action among group members. Such a social cohesion stabilises, guides as well as it constrains action and it offers a distinct sense of belonging. The elements that keep groups and societies together are said to be self-interest of its members, suggestion, coercion, idealism, mechanical habit, sense of duty, love, inertia, and faithfulness (Simmel 1950, p.379; cited in Misztal 1996, p.51); all feelings that create an atmosphere of obligation which ties "one element of society to another" (ibid., p.387). This mechanism of 'social glue' is further analysed from a societal perspective, later on in the frame analysis.

Group identities grow out of social structures just as social structures are created through group identities. As an example, by studying within the institutionalised, academic social structure such as the discipline of mechanical engineering, an individual has the opportunity to become a member of the group of 'mechanical engineers' and might take on this identity. In this case, a group-identity grows out of a social structure. When individuals increasingly share the same values, have similar goals and beliefs, a group-identity emerges, as it does e.g. for members of the online-community 'second life'. In this case, a new social structure emerges out of similar identities.

Categorising oneself as a member of a group is a process of depersonalisation, by which the individual sees itself as a cognitive representation of the social category rather than an individual. The self-concept contains meanings and norms that the person associates with the social category (Hogg et al. 1995; cited in Stets and Burke 2000, p.26). Normative aspects of group membership become the prototype and the individual usually acts in accordance with those norms (Reichert 1987, 1996; Terry and Hogg 1996; cited in ibid., p.27), which results in a kind of social stereotyping.

Group identification also influences the self-concept to be prototypical, and if there is no motivation to distinguish one from others, in-group homogeneity is especially strong, members feel a strong attraction within the group (Hogg and Hardie 1992; cited in ibid.) and a strong commitment to the group (Ellemers et al., 1997; cited in ibid. p.9). As a result, behaviour and decision making occurs in extreme concurrence (Turner et al. 1992; cited in ibid.). In sum, there is uniformity of perception and action among individuals that share a group identity; they "identify

with each other, see themselves in similar ways, and hold similar views, all in contrast to members of out-groups." (ibid., p.13).

5.6.3.2 Role-identity

Role behaviour is believed to be a reaction to those who are different, conditioned by the existence of these others. In this function, role-behaviour is often related to group identity: a relationship with the group that is recognized as different (Abdelal et al. 2001, p.8). In "identity theory", the core of an identity is the categorisation of the self as an occupant of a role, which comes along with the incorporation of that role and all its differentiation meanings, expectations and performances (Burke and Tully 1977; Thoits 1986; cited in Stets and Burke 2000, p.5). These expectations and meanings form a set of standards that guide behaviour. In contrast to group identity, it is the difference not uniformity in perceptions and actions that define a role and make it distinct from other roles and counter roles (Stets and Burke 2003, p.131). Role motivated behaviour lies in the decision to perform a role and to act it out in an 'appropriate way'. What is appropriate has two dimensions: each role has a "conventional" dimension that relates to the expectations tied to a social position and an "idiosyncratic" dimension, which refers to the unique interpretation and meaning, individuals bring to their roles (McCall and Simmons 1978, p.65; cited in ibid. p.134).

By taking a role identity, individuals adopt self-meanings and the expectations that come with the role as they relate to other roles in the group. Behaviour then represents and preserves these meanings and expectations (Thoits and Virshup 1997; cited in Stets and Burke 2000, p.10). Different from group identity, these meanings and expectations can vary across individuals in the set roles. If role-identity is to function, counter-roles and other roles involved must function as well; the reciprocity and exchange between roles is crucial (McCall and Simmons 1978; cited in ibid.). This is because individuals do not view themselves as similar, but as different, with their own interests, duties, and resources. Thus, while group-based identities can exist without interaction with other individuals, involving only the actor's own perceptions and actions (Turner et al. 1987; cited in ibid., p.12), role based identities can only exist with other individuals in the group, who occupy counter roles; without them, no role performance is possible (Stets and Burke 2000, p.12).

5.6.4 An argument for a combined perspective on group- and role-identity

Comparing the two identity traditions, group-identity in social-identity theory and role-identity in identity theory are both compositions of the self-concept and emerge through reflexive self-categorisation and identification in a social structure. Table 4 summarises and compares the two forms. The basis for self-classification is different in the two theories: it relies on similarities in group-identity while it centres on differences in role-identity. However, both knowledge streams recognize that individuals view themselves in terms of their own internal meaning system,

imparted on them to a large extend through a structured society (Stets and Burke 2003, pp.30-1).

Following a new stream of thinking in social psychology (e.g. Abdelal 2006; Epstein 2003; Leary and Tangney 2003; Mischel and Morf 2003; Pervin 2002; Stets and Burke 2003; Turner 2002), the author joins the merged vantage point for group and role identity. Within each relevant group, there can be roles and there are individuals playing out these roles; additionally, role and group-identities become activated in parallel within one situation (Deaux and Martin 2001; cited in Stets and Burke 2003, p.33), and they are likely to overlap. Looking at one form of identities while ignoring the other, is likely to result in partial understanding, because group and role-identities are simultaneously relevant to and influential on perceptions, affect, and consequently on behaviour. They influence and reinforce or suppress each other and cannot easily be separated (Stets and Burke 2000, p.15).

Table 4: Conceptualisation of group- vs. role identity

	Social Identity: Group	**Identity Theory: Role**
Identity Type	Group or category based identity	Role based identity
Perspective	Oneself as a member (in-group), competing with out-groups	Oneself in a role: fulfilling expectations of others
Basis of Identity	Uniformity of perception + behaviour;	Interconnected uniqueness;
Cognitive, attitudinal, behavioural pattern	Centres around similarity w/ others Acting in unison No interaction w/ others required Parallel relations	Centres around differences to others Acting in relation + negotiation to others Interaction w/ others required Reciprocal relations
Salience/ Activation	Focus on characteristics of a situation	Focus on social structural arrangements and links between individuals

The identity related perspective chosen to investigate technology acceptance behaviour further will be based on the assumption that an individual holds as many different social-identities as there are different group memberships and roles that one holds in society. They are "internalised positional designation" (Stryker 1980, p.60), and identities are the meanings one has as a group member, a role-holder, or as a person (Stets and Burke 2003, p.132). Consequently, the self has multiple identities, each of which is tied to aspects of the social structure[4]. As Stets and

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[4] There is discrepancy among symbolic interactionists, if there is such a thing as a social structure. One stream argues that any pattern is solemnly defined through the interpretation and definition or its actors (Blumer 1969; cited in Stets and Burke 2003, p.128) and individuals are free to define a situation any way they care. A structural

Burke (ibid., pp.132-3) argue, one must examine the nature of interaction between identities by addressing both, the social structure and the agency acted out.

Because individuals increasingly hold multiple and complex positions in a modern, networked society, the self and its identities become increasingly complex. Individuals often act based on two or more identities, e.g. as a colleague, mechanical designer and project manager. Such a parallel execution of identities can be coherent and smooth or conflicting, with contradicting values (ibid.). The interaction between identities within one individual and the interaction of identities between different individuals will be examined in this study.

To further understand the relationship between identities, it is helpful to understand when and why group and role-identities are activated and if there are individual or situational patterns that matter.

5.6.4.1 Aspects of social-identity formation

Self- categorisation and social comparison
Self-categorisation is the process by which the reflective self takes itself as an object and classifies or names itself in particular ways in relation to other social categories or classifications (Stets and Burke 2000, p.2). Through a social comparison process, persons who are similar to oneself are perceived to be the 'in-group', vs. the others that are categorized as the 'out-group'. The consequences of self-categorisation are an accentuation of perceived similarities between oneself and other 'in-group' members vs. the differentiation between oneself and 'out-group'. Such an accentuation occurs for all the attitudes, beliefs and values, affective reactions, behavioural norms, bodily attributes, styles of speech, and other properties that are believed to be correlated with the relevant 'in-group' categorisation (Tajfel and Turner 1979; cited in Fischer and Wiswede 2002, p.659). In a process of social comparison, the selective application of the 'in-group' "identity-markers" (Baron et al. 2006, p.177), can increase self-worth and self-esteem (Stets and Burke 2003, p.132). Important dimensions of comparison are usually social status and power, because they are understood to be rare goods in any society; however, this point has received mixed support as motivation for social-identity (ibid. 2000; p.29).

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approach acknowledges a relatively stable and durable society, with "patterned regularities that characterise most human action" (Stryker 1980, p.65). Only the acknowledgement of such patterned regularities allow for some form of collective identities that are discussed in this chapter. This research follows the second perspective.

Activation of social identities

Any individual has typically multiple role-identities and might hold various group identities. The question thus is: What makes a particular identity relevant in a situation?

Identity theorists (Stets and Burke 2003; Stryker 1980) see role-identities organised in a hierarchy. However, there is an argument, whether it is a hierarchy based on activation frequency or on the strength of individual values (Stets and Burke 2003, p.135).

Group identity theorists argue that activation is a combined matter of accessibility and fit (Bruner 1957; Oakes 1987; cited in Stets and Burke 2000, p.20), where accessibility is the readiness of a certain category to become activated. The fit is the congruence between stored category specifications and the situation (McCall and Simmons 1978; cited in Stets and Burke 2003, p.135).

Looking at both activation concepts, activation frequency has a lot in common with accessibility, while the strength of values have to do with the fit of the content. In this respect, the activation of social-identities might be conceptualised along the same lines, either by frequency, which is essentially accessibility, or by the content fit between an identities inherent values and beliefs and the situation.

According to identity theory, the commitment to a role has two aspects. The first is the quantitative number of individuals a person is tied to through the role; this reflects the degree of embeddedness in the respective social structure. The larger this number of ties, the more likely is the activation of the identity. The relative strength of these ties to others is the second dimension: strong ties to others through a role lead to a more active identity. To that effect, opportunities to activate role-identities might also be aspired: identities on top of a salience hierarchy are more likely to be activated, independent of the situation. They essentially create a new situation (McCall and Simmons 1978; Tushima and Burke 1999; all cited in ibid. 2000, p.24).

In identity theory, an important motivator for group membership is the reduction of subjective uncertainty. When individuals are uncertain about a subjectively important aspect, they gain stability and certainty from behavioural consensus with in-group members or from their affirmation (Mullin and Hogg 1999, p.91).

When an individual performs role or group behaviour along the 'identity standard', self-verification occurs, solidifying role or group-identity further (ibid.). 'Appropriate' role or group performance also enhances self-esteem. However, while group based identity performance enhances worth based self-esteem, role based identity performance enhances self-efficacy based self-esteem (Stets and Burke 2003, p.132).

Other motives for role or group-identity include self-consistency and self-regulation. Self-consistency and self-regulation are important to keep the situation consistent with identity standard, taking action to modify the situation so that

perceptions of the self are consistent with their individual reality (ibid. 2000, p.31). This again has to do with an individual's self-concept and self-esteem, which is protected under thread (Baron et al. 2006, pp.174-83). Looking at behaviour from this perspective, behaviour can be an act of self-protection.

Emotions are another significant element for social identification in a given situation. In highly emotional situations, such as anger or anxiety, and in situations of low importance, individuals are likely to use readily available cognitive patterns of social categories (Malinowski 1930; Tajfel and Wilkes 1963; cited in Fischer and Wiswede 2002, p.661). This reduces the cognitive effort necessary to decide between choices of action, because social-identity provides norms for 'appropriate' behaviour. Situations of technological change are situations of uncertainty, maybe even anxiety. Readily available social categories help making behavioural choices when one is not at ease with such change.

The final point to support some symbolic interactionists' attempts to merge identity theories to one concept of identity comes from the Harvard identity project (Abdulal et al. 2001, 2007). According to their findings, the readiness or accessibility of an identity to be activated has also to do with internalisation or habituation of constitutive practices.

One can conclude that role and group-identity are similar in their activation principles; selecting an identity is a matter of the individual interpretation of a situation through the individual and the individual's degree of embeddedness in the identity.

The larger social context
Important to identity theory are the categories people place themselves in, which are usually part of a structured society, and they exist only in relation to other contrasting categories. Individuals are born into an already structured society (Hogg and Abrams 1988; cited in Stets and Burke 2000, p.4), and individuals derive their identity or sense of self, largely from the social categories to which they belong. This results in a certain degree of uniformity of perception and action among individuals of the same group-based identity (ibid., p.9). Further details about the interrelation between society, its structures and the individual are the focus of the societal perspective.

5.6.4.2 Measuring identity
The "Harvard identity project" (Abdelal et al. 2007) offers two measures for the activation of identity, be it role or group identity: the content of an identity and its contestation.

The identity content is the primary measure for any form of collective identities. It can be categorised in (1) constitutive norms, which are written, unwritten, or codified but they always refer to practices that lead to individual obligation and social recognition; (2) social purpose, where a group attaches a shared purpose in order to follow an interest; (3) relational comparison, where exclusivity, status, and

other foundational distinctions are highlighted; and finally (4) shared cognitive models, in a broadest sense world views, that aid understanding and interpretation (ibid. p.7-15).

Contestation defines the degree of agreement within a group over the content of a shared category. This is relevant because the content of identities is neither fixed nor predetermined; rather, it is the outcome of a process of social contestation within the group. Individuals are continuously proposing and shaping the meanings of the groups and roles to which they belong (ibid., p.16). Contestation, therefore, includes the degree of within-group agreement about the constitutive norms of an identity; consensus and congruence of the social purposes ascribed to an identity; agreement about meanings attached to out-groups; and coherence of shared cognitive models (Abdelal et al. 2007, p.19). In this respect, contestation might be a measure for the activation of a particular identity.

5.6.4.3 Corporate Identity: Identities of corporate actors

Individuals, states, churches, firms, political parties, and basically all corporate actors can have an identity, or a corporate identity (CI). This is a recognised value in business science, and is sometimes even related to as a corporate equity. Since this study investigates identities in an organisational context, corporate identities will be discussed. Corporate identity in business science usually incorporates the visual appearance 'corporate design', the corporate communication and corporate behaviour to express the added value of the organisation (Heller 1998, p.18). This form of identity does not match the definition of identity in this study. However, setting corporate identity in the same social-cognitive context as group-identities, it emerges from the interaction between what the corporation wishes to be and what its environment wishes it to be. This interaction leads to various identities in multiple social-cognitive contexts (Peverelli 2006). Individuals identify with a company as a whole in a form of group identity. The focus of this work is on the individual, thus, if there is a corporate identity that individuals relate to, and that is of influence on technology adoption, this identity will emerge from the field research and a social identity.

5.6.5 Personal identity

So far, the investigation of identities showed that they represent an individual's embeddedness in a structured society: as members of groups or agents that create roles. However, there is another component to the self, inherently personal, pre-existing physical and psychological: "personal-identity" (Martin and Baressi 2003; Thoits 2003, p.181), also referred to as "person identity" (Stets and Burke 2000, p.16).

Personal-identity is relevant for both forms of social-identity and is often on the same level with personality. This identity derives from what Mead called the "individual self", the "I" (1934, p.214). Personal-identity is said to describe 'who one truly is'; the undetermined unique human thought and behaviour that attributes

to individuals' free will, spontaneity and creativity; all the elements that attribute to "personal agency" (Thoits 2003, p.181). In an analysis of ordinary language, Fearon (1999) found personal identity to be what everyday-language expresses when talking of 'identity' "the bases for one's dignity, self-respect or pride" (p.32). Individuals feel 'real and authentic' when they act in accordance to their personal-identity. Various studies show the relevance of the integrity of action with personal-identity for one's well being and health (Thoits 2003, pp.181-2). Since the personal self is the innermost self, it represents the cognitive self-structure, the processes and motivational dynamics, through which self-integrity is perceived, monitored and maintained (Steele and Spencer 1992). Such integrity between the various parts of the self and behaviour gives a powerful sense of coherence; a feeling of stability and wholeness. This self-integrity is so important to individuals that they subconsciously fight to maintain it (Swann et al. 2003, p.367). Personal-identity influences the acquisition of social-identities; it penetrates them to provide overall self-integrity between action and one's self (Stets and Burke 2000, p, 18). In this function, it can provide stability across various social-identities and situations (ibid., p.34). The importance of self-integrity becomes apparent, when looking at the psychological automatisms to protect self-integrity subconsciously.

5.6.5.1 Processes to maintain self-integrity

Based on the need for self-integrity and its protection, behavioural theories have developed an understanding for processes that might offer explanations for difficult to understand technology acceptance behaviour and its justification by the individual. All these processes are based on the human need to justify action in the light of one's self-concept, the feeling of guilt, if one fails to do so and the desire to reduce these dissonances.

Self-verification theory

Self-verification is the process whereby the individual seeks confirmation of its self-concept; it is said to be one of the most powerful forces of the self. Once individuals have established and maintained their "patterns of living" (Swann et al, 2003, p.367), these patterns provide individuals with a powerful sense of coherence and self-integrity, which can affect health. Since self-concepts are inherently linked to these patterns, self-concepts and a feeling of self-integrity become intimately tied. This may be true even if the self-concept is negative, and therefore in conflict with the desire to maintain a positive self-view. In this conflict, the self-verification wins (Swann 1990; cited in ibid. p.377).

Cognitive dissonance theory

Cognitive dissonance theory (Festinger 1957; cited in Aronson et al. 2005, p.166) deals with the discomfort that occurs when behaviour is inconsistent with the self-concept. Individuals are motivated to reduce this discomfort by either changing behaviour or by justifying behaviour through changed cognitions. If past behaviour cannot be undone this 'after-the-fact' dissonance compels one to change one's

beliefs. Beliefs resulting from such self-persuasion are said to be more permanent than beliefs that origin from outside the self. Cognitive dissonance is in disagreement with self-verification theory, and the dispute cannot be settled (see e.g. Swann 2003, p.369; Steele and Spencer 1992).

Self-discrepancy theory
Self-discrepancy theory deals with the idea that individuals are motivated to maintain a sense of consistency among various beliefs and self-perceptions. Consequently, individuals become distressed, when one's sense of the actual self differs from the aspired self-concept. (Higgins 1987; cited in Aronson et al. 2005, p.188). As with other discrepancies, one will act to reduce this dissonance by various means.

Self-affirmation theory
A related theory is the self-affirmation theory (Steele, Hoppe and Gonzales 1986; cited in ibid. p.192) which argues that when the impact of a thread to self-integrity cannot be reduced directly, the impact is reduced by affirming one's ability in some other area.

5.6.6 Reflection on identity concepts: A merged perspective
As this investigation has shown so far, the self is not an undifferentiated whole, but a complex system that involves multiple and diverse parts and processes, reflecting the complex and diverse society the individual acts within.

Each identity is an individual's location in the social structure from the individual's personal point of view. So when an individual holds multiple positions in society, that person has multiple identities: e.g. as a design engineer, a member of xy company, a family member, a father, a musician. They are all tied together in one self-concept that aims for self-integrity. In order to understand this final merger in one self-concept and its consequences for behaviour, group-, role- and personal-identity should be looked at in combination. Both group- and role-identities are expressed along normative lines, where individuals act in accordance with a social structure (Stets and Burke 2000, p.28); a structure which is reciprocally reinforced through role- or group-compliant behaviour. Both categories are embedded in societies' dominant culture, which made MacKinnon and Heise (forthcoming; cited in Smith-Lovin 2007, p.110) call them "cultural identities". They argue that role-identities indicate positions in the social structure and group-identities indicate membership in groups. Personal identity infiltrates group- and role-identity just as role-identities may infiltrate group-identities (Stets and Burke 2000, pp.16-7), aiming for coherence between them. Research suggests that situational factors distinguish if personal, social or role-identity are predominantly active. In a situation of social comparison, or normative fit, social awareness is increased and social-identities are activated. To the contrary, mirrors or cameras increase self-awareness as an individual and thus personal identity becomes activated (Scheier and Carver 1983, pp.126-7).

To further understand technology acceptance behaviour, one must understand how these three identity types operate simultaneously in one situation to influence behaviour. When studied together, one can show how individuals are constrained by social identities' normative or structural frames but how they also have some choice in their enactment through personal identity. The struggle for self-integrity is the struggle between these sometimes-opposite forces. Behaviour can be very consistent and assured when it is based on correlating values of parallel activated group, role and personal identity, tying all three levels of identification into one, coherent action. To the contrary, when meanings and expectations associated with a social-identity conflict with the meanings of personal identity, or when social-identities conflict with each other, individuals may ignore role or group-identity to maintain personal identity or the other way around. Stets (1995, p.143; cited in Stets and Burke 2000, p.18) speaks of a balancing act between the demands of social-identities and personal identity. He observed individually different hierarchies of identities, and that social-identities cannot just ignore personal identity. Nevertheless, it is likely that when identities are competing, individuals become distressed; a situation of choices occurs, where no one choice leads to a balanced feeling of self-integrity. An integrated view on the various identities within the situation of technological change might hold clues, which lead to further understanding for technology acceptance behaviour.

Identities become obvious and can be interpreted through an individual's goals, life tasks, values, self-evaluation, motivations, self-regulations, and self-theories that are expressed (Cantor et al., Emmons 1989, 1991; Mischel et al., 1996; Pervin 1989; Zirkel and Cantor 1990; all cited in Mischel and Morf 2003, p.30).

5.7 A functional model of a self-system

The symbolic interaction models of behaviour and the self-system offer a lot of understandings and explanations about human behaviour, however, the workings of a self-system that is responsive to context, harnessing inter-situational behavioural variability, while at the same time remaining relatively stable, none the less appears paradox.

Contemporary neural network models of personality offer explanations and insights into such 'dynamic – not dynamic' workings of a meaning system. A perspective that, in its consequences and findings, is close to the meaning system approach of symbolic interactionism; reinforcing this observation is a recent article, where such a model has been described as "networks of meaning" (Mendoza-Denton and Hansen 2007).

5.7.1 A cognitive-affective processing[5] system (CAPS)

The cognitive affective-processing system has been developed to explain paradoxical findings between the "invariance of personality and the variability of behaviour across situations" (Mischel and Shoda 1995, p.246) which increasingly bothered personality psychology during the last century. Unlike most contemporary personality theories, this concept emphasises the effect of situations and contexts onto the conception of personality.

A uniquely networked system of cognitive-affective representation units characterizes a unique individual. The representations are personal variables that represent different self-processes: encodings, expectancies, affects, values, competencies, and self-regulation (ibid. p.253). While these representations are not particularly different from symbolic interactionists' models, the explanation of the underlying organisation of the elements that construct a representation is of interest: it is a network of interrelated units of meanings that operates as a whole. Some of them are input units, others are hidden units not visible nor conscious, but mediating the process, and yet others are output units that contain the result of the process, which is transformed in behaviour (Garson 2007). The basis for this approach is the metaphor of neural network models used in "connectionism" (Mischel and Morf 2003, p.24).

Individuals' representation units differ among each other (e.g. values, expectancies), and they differ in the way they are connected to each other (e.g. their links and the strength of the link). The network's uniqueness is a result of an individual's genetic endowment, biological history (e.g. temperament), as well as his or her social learning and development history within a particular culture and subculture (Mischel and Morf 2003, p.26). In this metaphoric picture, cognitive-affective units and their unique relationship in the network provide a natural bridge between the cultural context on the one side and the individual and its biography on the other (Mendoza-Denton and Hansen 2007, p.73). This network is considered relatively stable. Dependent on the various stimuli in a situation, some of these cognitive-affective representations are activated and a networked process of connected units starts (Mischel and Morf 2003, p.16).

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[5] This system was initially introduced as:"cognitive-affective personality system" (Mischel and Shoda 1995) later work now refers to it as "cognitive-affective processing system" (Mischel and Morf 2003; Mendoza-Denton and Mischel 2007; Mendoza-Denton and Hansen 2007).

> *Thus, what constitutes a situation in part depends on the perceiver's*
> *constructs and subjective maps, that is on the acquired meaning of*
> *situational features for that person, ... individuals differ in how they*
> *selectively focus on different features of situations, how they*
> *categorise and encode them cognitively and emotionally, and how*
> *those encodings activate and interact with other cognitions and affects*
> *in the personality system.*   *Mischel and Shoda 1995, p.252*

This individually different interpretation of a situation results in an individually different, specific set of effective stimuli that "hits" the self-system of the individual.

The neural network model offers a conceptualisation, that is sensitive to different features of situations, and it can respond to them in characteristic and stable ways. Figure 16 and 17 illustrate such activations.

They demonstrate how one single variation (red arrow) in the selected stimuli factors changes the overall behaviour; a typical phenomenon of complex systems that is further explained when network societies are discussed in the societal chapter.
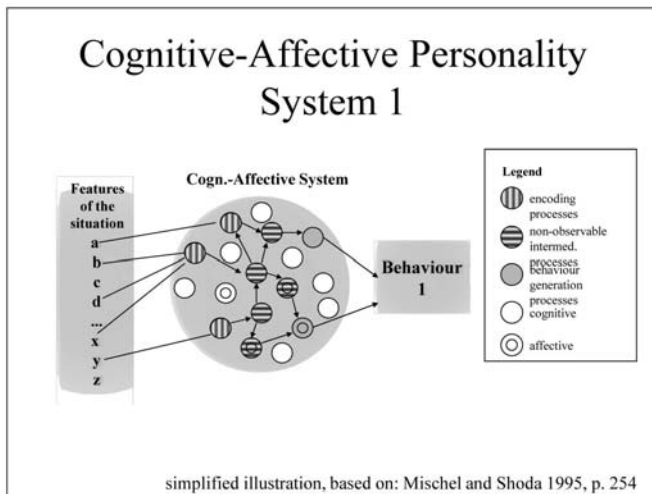
Figure 16: The function of the cognitive-affective personality system
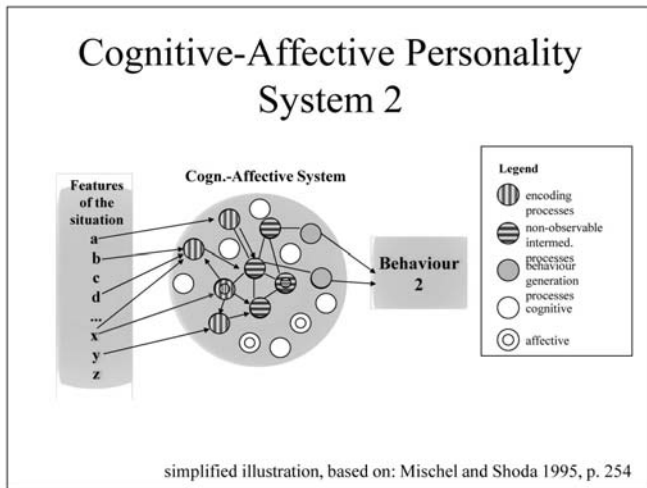
Figure 17: The function of the cognitive-affective personality system with a slight variation in stimuli

Socially derived meanings are available as cognitive-affective representations. Mendoza-Denton and Mischel (2007) use a metaphor of colouring crayons to illustrate different cultural content, such as social identities. The world 'out there' is the blank colouring book and different identities make different sets of colours available to their members; some colours are simply not in the colouring box of an individual. Once the crayons are available, they might differ in their accessibility: does the concept easily come to mind? Is the colour in front of the crayon box or hidden in the back. Last, there is applicability: What colours are considered to be suitable to colour a specific object? Which ones are not considered at all? Applicability has to do with internalised understandings.

The connectivist model offers further explanations. Any representation is a whole system of small, connected higher and lower level units, and each unit can be involved in many different representations. When interconnected units send activation to each other over weighted links, the content of each unit and the weight of the link changes slightly. This means that any activation and the change that occurs to its units, affects other meaning (Mischel and Morf 2003, p.24). Furthermore, when representations are the result of different patterns of activation across many units, they cannot be 'stored for recall', but are reconstructed each time they need to be activated. Unfortunately, memory is said to be imperfect, so within the networks of meaning, the content changes, the strength of links changes and the memory about its activation is flawed. All factors that result in a variety of different interpretations of a similar situation (ibid.).

However, the system is also very stable: it has its individually different distinct through constructs such as the self-concept and identities; in this respect, it is bias by the connections and weights already formed in the system (ibid. p.30). While these connections and weights can change, this happens slowly and through subtle adjustment (ibid., p.26). The mind changes slowly but constantly through social learning and developmental history.

5.8 Conceptualisation of an individual's meaning system

Based on the compiled understandings so far, the following conception of a dynamic meaning system balances the hard to understand invariance of personality and the variability of behaviour that is easily read as irrational and confuse. This conceptualisation is neither radical nor completely new. It is a bricolage (Turkle 1995, p.51) of existing knowledge, assembled from different disciplines. It takes the dualistic self-concept of symbolic interactionalism, attempts to merge its identities into one self-concept that aims for self-integrity, combines it with the discriptive logic of a cognitive-emotional processing model of personality, which borrows explanations from neuroscience and network logic.

5.8.1 The self-system as part of a cognitive-affective meaning system

The self-system is part of a motivated meaning system, which builds, maintains, promotes and protects its self-concept over a lifetime. Meaning, such as values, believes, etc. is constructed in particular networked connections of representation units of this meaning system. Particular network connections stand for the different meanings that an individual holds in the social structure. Additionally, personal identity reflects the inner drives, goals, desires and understandings that are unique to each individual. One can speculate that personal identity emerges from the unique organic structure of the network. What makes this process so hard to grasp is that a meaning-system is a developmental process in which the self-system that emerges is in part its product and in part its architect. To use the metaphor introduced earlier, the self-system is the writer and the reader of the book of meaning, just as it is part of the book itself.

Which identities are activated in parallel in a specific situation, depends on the amplifying and attenuating attributes of the situation and the selective focus among all possible stimuli. Furthermore, it is dependent on the spectrum of identities available to the individual, which depends on the degree of embeddedness of the individual in the various groups and roles society offers. The sum of all activated identities and their internal balance, is the self-process in action, also called "personality-in-context" (Zayas 2003, p.4), the "working-self" (Mischel and Morf 2003) or as in this study, an individual's self-identity. Based on this understanding, up to three identity types (group, role and personal identity) operate simultaneously in one situation. They influence behaviour by constraining action through normative or structural frames and they offer free space for innovative behaviour through the enactment of personal identity.
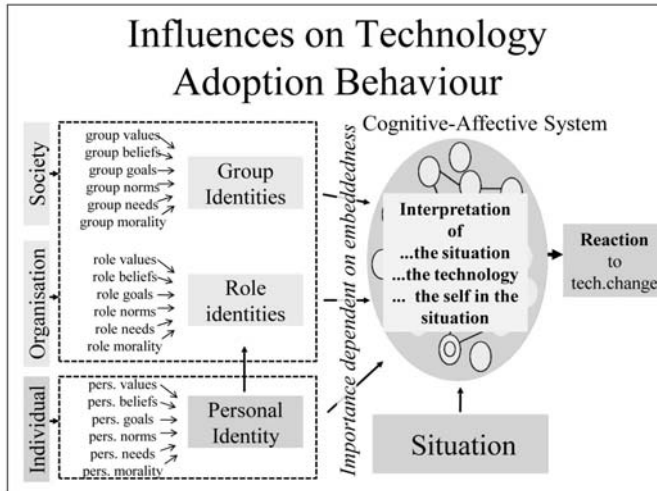
Figure 18: Conceptualisation of the self-system and its identities

Figure 18 illustrates the conceptualisation of the current understanding of the various influences that are involved in an individual's reaction to technological change, and their subjective weighting through the unique embeddedness of the individual.

Finding out, which identities are active in a particular situation of technological change, and to what degree they influence behaviour, is likely an important aspect to further understand an individual's interpretation of a situation of technological change and its respective behaviour.

6. Societal Perspective

The sociological approach to understanding the self and its parts (identities) means that we must understand the society in which the self is acting… . The nature of the self and what individuals do depends to a large extent on the society within which they live… .
<div align="right">*Stets and Burke 2003, p.128*</div>

6.1 Introduction and chapter overview

This chapter offers an historical and contemporary analysis of different social realities. These realities are important, because they offer the foundation for social structures, and it is this social structure, within which a society places its categories for social identities. This means identities are linked within the social system (Smith-Lovin 2003, p.174), which means that individuals are not free to define their social categories. As all social choices are socially constrained (Stryker and Stratham 1985; cited in Thoits 2003, p.182). Furthermore, social structures and meaning systems which include the self are in an reciprocal relationship of influence. This chapter focuses on the investigation of these often hidden constraints. Uncovering them will further increase an understanding for the choice of available identities and for the identity content that enables or constrains enactment. Once the social heritage of the spectrum of choice and limitation is understood, the investigation will continue with the role contemporary information technology has on society and on the individual. Opportunities and threats are investigated, and the possible perceptions within the social context are discussed. Special recognition is given to emerging network societies, a technology enabled new form of social ties, which also might account for individuals' perceptions in a situation of technological change.

6.2 Why do social structures evolve and change

In order to understand the role of social structure in identity formation, it is necessary to discuss the background of why societies evolve. It is not necessarily obvious why individuals trade complete personal liberty for a common bond of rules and restrictions.

Many theories offer explanations and many seem to agree that it is the basic human instinct in survival and the interest in a secure, predictable environment that lies at the root of the adjustment of individuals into groups and communities. There are interest based theories (Spencer 1884, Toennies 1922, early Weber 1904) that see social order as the unplanned convergence of individual interests. Others (e.g. Comte 1848) argue for a consensus of wills, rooted in common experiences. Yet others (e.g. Simmel 1917; Durkheim 1956) see moral consensus as the source for

social integration, a perspective that is still present in many contemporary thoughts (e.g. Giddens 1991). Some theorists emphasise that force and pressure are required in order to integrate individuals into a social structure that benefits elite individuals, a viewpoint that goes back to the "natural rule of the strongest" (Rousseau 1762, bk.2, ch.6-10). Last, most scholars who discuss the 'modern society' see social integration into a social order as a multi-dimensional issue. The following paragraphs will highlight more details on a small selection, that might have some impact on this research study.

Weber (1922, part1, ch.1, §1) saw socialisation as a development from pre-rational (emotional and traditional) to rational action (ibid. §2, §7). He perceived such a development as unavoidable, due to an increasing population and increasing property ownership (ibid. part 2, ch.8). To Weber, mutual interests and functional interdependences are sources for social structure.

An emphasis on relationships and interactions highlights Simmel's explanation for the development of a social order. He believed that society is made up of a number of individuals, connected by interaction and exchange that create an inner bond of reciprocity between them (Simmel 1917, ch.2). While economic cooperation is reinforced by legal rules, social cohesion needs to be secured by feelings such as courtesy, gratitude, honour, idealism, habits and a sense of duty (Simmel 1950, pp.386-7; cited in Misztal 1996, p.51). Feelings   create an atmosphere of obligation, as well as a sense of belonging and reliance.

Both Weber's and Simmel's conceptualisation of modern society is complex and ambivalent because it stresses the freedom brought to individuals by dissolving traditional bonds, while emphasising a sense of belonging and reliance on the social system. An ambivalence that is resolved through a fragmentation of an individual's life-spheres into different groups (Misztal 1996, p.54), which leads to different group and role-identities within one self.

Giddens (1989) defines society as a "system of interrelationships which connects individuals together" (pp.22-3) in a social structure (traditions, institutions, moral codes and established ways of doing things). Such social order is manifested in two major ways: there is habit and routine, "a critical bulwark against threatening anxieties" (Giddens 1991, p.39), and there are other people's expectations which create a social force that makes it difficult to act in any way that one wishes. Individuals try to maintain this shared framework of reality in order to maintain ontological security in everyday life (ibid. p.33).

Both Simmel (1917) and Giddens (1991) identify an element of natural and moral order, which ensures solidarity and directs behaviour through feelings of obligation, the desire to be respected and appreciated as well as a desire for altruism. In this case, feelings promise certain predictable action, but in contrast to normative order, they are inherently human and not obviously institutionalised.

Foucault (1972d) gives a different answer to the question of why individuals created a society and where feelings of obligation come from. He pictures the evolution of social order as complexity with no path, no cause and effect and no obvious choice (Poster 1984, p.74). Historical analysis in general is only a means to influence human consciousness (Foucault 1972a, p.12) and to activate self-control through undercover institutionalised through. A subtle set of micro practices such as common discourses, common knowledge etc., direct feelings of obligation (ibid., 1972b, p.30).

Social network theory offers yet another perspective. Using this theory, the social structure of a network emerges based on the location of resources necessary for the individual. Social networks are cognitive constructs, defined as "a set of nodes (e.g., persons, units, organisations) linked by a set of social relationships" (Laumann et al., 1978, p.458; cited in Marx 2004, p.71). It is the idea that relationships link interdependent subjects; these relationships can be structural, positional, relational, and cognitive, and there are different means to analyse them: tie strength for relational embeddedness, the degree of autonomy for structural embeddedness, centrality as the degree of positional embeddedness and shared values reflect cognitive embeddedness (ibid., p.80).

Independent of society's origin, when the underlying system of meaning changes, society changes; this can happen when people start to ignore the meaning, replace it or reproduce it differently. Whatever the basis of social order, it changes, whenever the underlying structure changes or dissolves (Giddens 1998, pp.22-3).

Reflection
This small selection indicates that the underlying motivation for social structure might have more than one origin. The majority of theories favour a combined rationale of two elements: the self-interest in social stability, rooted in a desired predictability of other individuals' behaviour, and the simplification of one's own conduct; additionally and more controversial, in a deeper causal 'moral' structure which subordinates individual interest to a larger social whole (Misztal 1996, p.208).

In sum, social order offers stability, reliability and predictability; however, it also restricts behaviour. There is no consensus as to whether these restrictions are on behalf of larger society or on behalf of a social elite group.

6.3 Social realities: an assessment of the self and technology through the centuries

...first, that man might be better understood if he were viewed in the perspectives of the centuries rather than in the flicker of passing moments; and second, that each man contemplates in his own personal way the streams of events upon which he finds himself so swiftly borne.   *Kelly 1991, p.3*

Social realities are the perceived truth of social groups or whole societies. While it seems easy to look back and identify bias perceptions in past societies, it is not easy to identify the contemporary, social reality, the internalised, taken for granted beliefs, values, standards and norms, as one perspective with alternatives. Rather, the immediate social reality appears natural and alternatives usually are not realised. Social reality becomes one's consciousness and any offence against these internalised norms results in a form of guilt (Fischer and Wiswede, 2002, p.64).

This chapter attempts to uncover the bias inherent in today's dominant business and social culture, in order to understand its influence on human behaviour in the context of technological change. To achieve this, past societies' social realities will be analysed in order to understand the mechanisms involved. The social-cultural context will be discussed in perspective as it relates to society's perception of 'the self' and of technology. Based on the evolving patterns of social influence on individuality and technology acceptance behaviour, today's monoculture of technical, capitalistic rationality is unveiled and technology's inherent social bias becomes obvious. However, new trends of multi-cultural diversity and technology enabled social diversity broaden the spectrum for an increased consciousness of social bias, changing social reality further.

6.3.1 Stable, strongly stratified societies
In a strongly stratified society, dominated by military goals, religious aims or intellectual claims, social order is ensured through 'cohesive ties by higher order', that are perceived as postulates for individual survival (Misztal 1996, p.35). Questioning this existing social order was unthinkable for most, since this appeared to be going against nature or God, bearing not only worldly but also spiritual sanctions. Early societies changed slowly and were considered stable societies. They were characterised by tight local community ties and rigid external structures that ensured stability and predictability. Custom and tradition easily turned into habits and routines that created feelings of security and stability, while they limit freedom (Giddens 1991, p.36; Misztal 1996, p.102).

In these societies, the whole defined the part, and social identity was rooted in the "shared practices and understandings of everyday life" (Coulhan 1994, p.6). Some see the 'self' discovered in the middle ages (Logan 1987, p.15), however, medieval biographies do not describe unique individuals but immaculate moral virtues that serve "the typical and the general" (Weintraun 1978, p.58; cited in ibid. p.16). Logan (ibid.) hypothesises that the emerging self-sense was a "non-self-conscious sense of 'I'"; an individual's sense of separateness from the larger whole.

Turning to the role of technology, the antique Greek established a common understanding concerning technology that was understood as productive knowledge, derived from theoretical knowledge (Plato c.427–c.347 BC; cited in Micham 1994, p.119). This implies that without theoretical knowledge, technology cannot be understood and, therefore, it cannot be judged. This inherent logic replicates elites' social order through early and middle age societies: in the case of

Greek antique society, intellect, the highest value of Greek culture, legitimised the rights of the ruling class to define how technology is judged. All strongly stratified cultures implemented their values as divinely ordered and incorporated technology for their purpose as an instrument of good or evil.

6.3.2 Renaissance and enlightenment

In the 16th century, under the influence of scientists such as Galileo, Descartes, and Newton, tradition and speculative scientific claims slowly gave way to claims of scientific knowledge, with the certainty of reason (Giddens 1991, p.83). This shifted power from the Gods and those that spoken in the name of them, to the individual. Emotionally linked "Gemeinschaften" ('communities') (Toennis 1988; cited in Misztal 1996, p.38) transformed into societies and the self progressed. Elite male individuals spend their time "advertising their own excellence and quarrelling over trifles" (Easton, 1966, p.312; cited in Logan 1987, p.17) all through renaissance. This group's social identity allowed them to "have effects on the world" (ibid.); Calvinist ideas and the protestant ethic are further signs of individualistic achievement motivation (Weber 1905). Rousseau (1762) e.g. distinguishes between two conflicting wills in one individual, the "general will", which is common to all and aims for the general welfare and a "particular will" that belongs to the individual and aims at personal well-being (bk, 2, ch.1, ch.4). Individuals are confronted with the task of balancing self-interest with social sentiments. Speaking in the terminology of social psychology, individual identity is discovered through reflexive thought. As Logan (1987) argues, only a "detached 'I' could conceive of such systems of thought" (p.20); the self started to be apprehended as something 'inner', something personal.

With the industrial revolution, technology became causal to progress and technical progress, and societal progress became intertwined; a 'new religion' that placed faith in mechanisation over and above that of human ability. Technological changes of the time (e.g. steam engine) offered evidence that such faith was justified (Purcell 1994, pp.38-9; cited in Chandler 1995) and technological knowledge became equivalent to power. Common understanding was that it had been nature and reason, if not God, that commanded humanity to pursue technology (Kant 1784, 3d thesis; cited in Mitcham 1994, p.285). Technology, technological activity and technological change were perceived as value-free tools of change in the name of progress; a common sense instrumentalism that treated technology as a humanly controlled, neutral means, requiring no particular philosophical explanation or justification.

This explanation justifies the motivation of the elite, but it does not explain why the masses accepted technology. It seems that for them, the socially constructed ideals of morality continued to ensure social order; as it is said that notions of morality are stronger and more certain than notions of trust (O'Neill 2002), these mechanisms of power continue to work well. Besides actual morality, the tradition of the existing morality further sustains rule following behaviour.

6.3.3 The break of modernity and technical instrumentalism
The awakening of modern society came with an increased industrialisation and urbanisation towards the end of the 19th century (Misztal 1996, p.208). Social change became more and stable social periods less frequent. Industrial progress enforced new economic dependencies and destroyed the traditional community solidarity (Castells 1996; Giddens 1991; Luhmann 1997; Misztal 1996). Increasingly, a bureaucratic structure replaced weakening cohesive ties; laws, and rules ensured social order, where common morality no longer held society together.

What started slowly with early industrialisation, took hold of the entire society and gave way to new social behaviour: technical rationality and capitalistic self-interest became the new driving forces behind human action and religious or metaphysical reason were strictly separated (Wesseling 1998). Modern societies were comprised by 'goal- and value-rational thinking' (Weber 1922, pt.1, ch.1 §7). Bureaucracy, law, and routine behaviour based on society's formerly tight moral code to trust authority (Misztal 1996, p.28), controlled those that had to bear the negative effects of industrialisation on the factory floors. Meanwhile, those that benefited from the new capitalistic understanding were able to manifest and institutionalise the new culture. As a consequence, technological critique became social critique, challenging the entire social system and placing any individual engaged in such critique outside of what could be socially accepted. The mechanisation of many aspects of social life permitted greater accountability, controllability, and prediction, and technology became the underpinning logic of confidence. The progress of society and the triumph of technology over the 'inadequacies of nature' strengthened the argument that technology was a humanly controlled tool, invented to serve the people.

However, this technocratic thesis started an antithesis. Technologies observable effects on society became visible and alternative interpretations of technology became possible (Feenberg, 1999, p.2, 9). What followed was a twin development of 'revolution and romantic'. This was possible because the self was encountered as a subject (the 'I' as it is demonstrated to the outer world) and an object (the 'me' or introspective, reflective self). Romantic writers now described the full spectrum of "the drama of an idiosyncratic inner life" (Lyons, 1978, p.70; cited in Logan 1987, p.21). Marx, Darwin, Weber, and Spencer, all described new theories that addressed the suggested phenomena: the impact of history, evolution, social structure, social change and the economic system on the individual. While the story used to be "how I influence the world", it now became "how the world influences me" (ibid., p.22). Not surprisingly, this time was full of political change, and in many western countries democratisation preceded.

6.3.4 The 20th century – high modernity
The adversative perception of technocracy vs. romantic thinking became available to a broader public in high modernity, and as a consequence, social awareness developed in two directions. Technology standardised and generalised processes in

modern society (e.g. Beck 1997, 1986; Castells 1996, 1997, 1998; Giddens 1990, 1999; Weber 1956, pp.181-2); this standardisation and generalization comprised the idea, and for some the ideal of technocracy: a generalized society, functioning along a neutral, unified, and normalised instrumental rationality.

Technology and technological knowledge has created boundaries around what has been acceptable and what has not, described as a phenomenon called "institutional reflexivity" (Giddens 1991, p.149), where technical expertise is embedded in the administration of modern societies. In so doing, it has disqualified individuals from participating in decisions. Technical expertise and knowledge has overruled democratic debate. Nuclear power is an example, where participation has been found to be impossible, due to the technical complexity of the matter, which has voted down the will of the people (Habermas 1970, p.61; cited in Feenberg 2002, pp.8-9). Technocracy has become therefore, a threat to democracy (ibid. 1999, p.101).

The difference in previous, historical conditions is that this new elitism includes education and knowledge rather than pure tradition, habit and heritage. However, extreme positions invite counter positions in an increasingly reflexive world. The freedom and peace movements of the 60s and 70s brought a new social awareness and increased critical evaluation of the existing social reality by an intellectual upper middle-class. Marcuse (1964), Foucault (1977, pp.206-7; 1972a, pp.4-12), and later Bourdieu (1985, p.231), discussed new dimensions of social reality and their subsequent social order. They acknowledged social membership as important; however, they described a fragmentation in social sub-groups and the increased freedom of modern individuals to choose their place in society. Society as a whole becomes fragmented and there is an increasing individual choice as to "who to be" in society and as a self. The self must be undertaken the effort 'to be found' or 'made', and a life devoted to the present became the movement of a whole generation. Increasingly, the 'true self' has become 'me' not 'I' (Logan, 1987, p.23). Social order and hierarchy became more flexible and mobility within society has increased; new social means have been discovered that maintain social order. No longer can open oppression and domination enforce order; bureaucratic rules and laws have offered a normative frame. Individuals themselves have excised self-control that has guided and restricted behaviour. The social values and morality inherent in self-selected group and role-identities guide action. Aspired reputations and prestige have created internal pressures to conform with an expected or aspired collective identity (Bourdieu 1977, pp.72-95; Foucault 1972a, p.30; Dreyfus and Rabinow 1983, p.110).
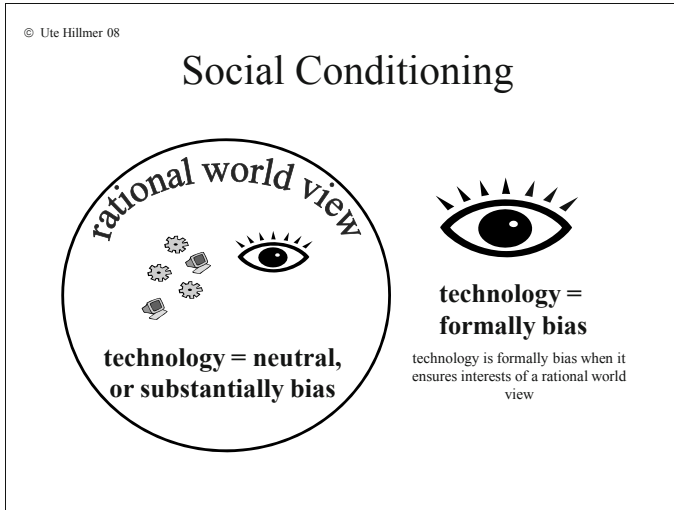
Figure 19: Social conditioning

A second concept that emerged is that knowledge and truth have been manifested in the public dialog and in the media; these discourses have become the boundaries for socially accepted thinking and behaviour (Foucault 1972b, p.211), and socially excluded choices decay to non-existence. Consequently, thought, knowledge and truth are connected to power through a web of social forces, obtained through a common reality which is perceived as natural, but which has been politically and historically influenced. When social reality is contested, technical constraint might be a political coercion. From this perspective, rationality is able to bias knowledge in order to legitimise itself and thereby, denies other knowledge. As Marcuse put it, the world has become "one dimensional" (1964, p.154) because critical consciousness have been bounded; a system theory with no space for opposition. Increased individualism enables awareness for a monoculture. When individuals of the intellectual elite placed themselves outside the predominant social value system, they gained a perspective from where to criticise the existing social monoculture, as illustrated in Figure 19.

Both Marcuse and Foucault e.g. threaten rationality as a whole. They analyze the bias of knowledge that legitimates technical rationality as the basis of a new social value system (Feenberg 2002, p.67). Until the 1960s and 70s, the dominant social realities concerning technology reflected the perspectives of the power elites. By criticising technical rationality, one automatically has criticised the entire social value system. Technology critic has become social critic. However, since most individuals are embedded within the dominant social value system, they have no critical consciousness. For Feenberg (2002, p.69) this explains, "Why the social imperatives of capitalism are experienced as technical constrains rather than as

political coercion." It might also indicate that resistance targeted towards a particular technology might be the expression of an underlying resistance against the social value system of technological rationality.

When human interest that is built into technology is ignored or denied, technology itself appears intrinsically bias. Such determinism of technology implies that by using technology, an individual becomes influenced by it. Technology has an impact on the individual and on society, which can be good or bad (Feenberg 1999, p.2; 2002, pp.63-4). One of these deterministic positions is substantivism. Fuelled by new scientific evidence about the human mind and psychoanalysis, mechanisation now represents in people's minds a tool that transports particular values; in the case of technology it is primarily that of rational logic. When machines are used to connect with the world, they become the link between humans and reality (Lucas 2005, approx. p.4) which in turn frames and limits cultural choices (Heidegger 1954, pp.15-9).

In its extreme position, the human experience has become devoid of choices as technical autonomy has grown. In the view of some, technology has become autonomous (Ellul 1964, p.14; cited in Feenberg 1999, p.3). From this perspective, technology is seen as "out of human control", changing under its own momentum and "blindly" shaping society (Chandler 1995, approx. p.5); a threat to human freedom and individuality. Examples such as the destructive power of the atom bomb in World War II gave evidence to such thinking. It is thought that rational thinking could proceed without the influence of social morality; a perspective where technology is a social force by itself.

Based on the opposing developments of institutionalised instrumentalism or technocracy, vs. critical substantive developments, common people's position in respect to technology has become increasingly complex. They must decide if they trust the dominant power elite, closely aligned with the overall social goals and with no critical consciousness, or if they are self-determined to choose their own position, following one of the choices offered by the intellectual elite. In this case, they must decide on what basis choices should be made. This could e.g. be self-interest or ethics. If it is ethics, they have to choose the social reality these ethics are grounded in. Life becomes full of choices, when formerly unquestioned common denominators of morality and solidarity vanish.

Following the legitimate social discourse of mainstream society, the business-world promises immediate economic well-being that brings the low conflict position of social conformity. Consequently, critical theories concerning technology have not stood up to the test that people are dependent on and embedded in the economic system. The majority has not wanted to be pushed to the edge of economic society, which is a common result of non-compliance: all through the centuries, disapproval and exclusion offered an effective way of sanctioning non-compliance with the social order (Weber 1922, part 1, ch1, §2).

Multiple theories explain this phenomenon. To live an active private, business, and social life, people need access to essential goods and services. Exclusion implies that society is shutting out someone from this essential access, cutting him or her off from full involvement in the wider society (Giddens 1989, p.323). Bourdieu (1985, p.723) argued that being excluded from one's "own" social group is an effective thread because such exclusion deprives the individual of its social identity. Foucault (1985) also argued along this line of embeddedness in meaning and identity: there is a moral solicitude, which leads individuals to question and monitor their own conduct (pp.10-1).

The theoretical spectrum of philosophies of technology that became possible in high modernity reflects this dilemma. Ignoring the larger social context, the specific details of each technical design have become the focal point of newly emerging theories in the 1980s and 90s, such as constructivism and the actor network theory; a strategy that moves the 'battlefield' from a macro cosmos to a micro-political context that bears the possibility to change the social value system from within.

6.3.5 The late 20th and early 21st century's social realities and views on technology

At the end of the 20th and the beginning of the 21st century, the influence of tradition and custom further retreat from social and individual live. According to Giddens (1989, 1998, 1999), Beck (1986, 1997), and Castells (1996, 1997, 1998) the world has entered a completely new era. New, networked, social structures emerge, the predominant culture remains capitalistic but hardened (Castells 2000, pp.210-5).

For Castells, it is the coincidence of new, enabling technologies, the transformation of knowledge and information as a primary production factor and a new consciousness for self-determination that enabled the changes. As a result, organisations and individuals are connected in a networked society, where they can collaborate on a global basis, pursue individual interests, and move in and out of relationships that are based on narrow aspects of mutual interest that require short term tolerance, but no consensus (Misztal 1996, p.228). Individuals develop ad-hoc patterns of social interaction, aware that the network in constant flux (Castells 1998, p.369). In a networked structure, social ties become wide, weak and collaborative. Individuals are no longer locally embedded but increasingly virtually linked, detached from space and time.

In contrast, Giddens still sees habit and routine (1991, p.39), and other people's expectations (ibid. p.33) as strong social forces, but additionally, he identifies increasing doubt about the truth of common knowledge and societies "common sense". Personal reflexivity becomes an individual's internal reference system and frame of action, influenced, but no longer directly related to mainstream social thinking. Giddens also identifies increased institutional enforcement of behaviour. Abstract systems of modernity, such as the labour market, the educational system

or the health system, enforce certain behaviour and penalize other; they enforce a degree of compliance (Giddens 1991, pp.137-9). Beck (1986) focuses his observations on risk, scientific truth and doubt. With ecological problems rising, scientific-technical development is no longer perceived as a problem solver alone, but increasingly a source of problems as well; the sound belief in the claims of knowledge, founded on the certainty of reason, crumbles. Complete control is lost, technological risk seems to grow out of proportion and experts frequently disagree amongst each other (pp.255-6).

All three scholars agree that the logic of causal development increasingly replaces the logic of cause-and-effect (Castells 1998, p.367; Beck 1986, p.317; Giddens 1999, p.26). Such causal, non-linear development is reflected in emerging social understandings such as a "risk society" (Beck 1986), where complete control is lost and doubt and uncertainty become a known feeling of everyday life (Giddens 1990, p.21). A growing 'global society' makes local identification even harder to maintain (ibid. 1999, p.19) and a pluralism of lifetime choices prevails. No longer is the question simply 'how to act'- it becomes a question about the self, about an individual's self-identity and choice of world-views: "who to be" (Giddens 1991, p.81). The consequences are two sided: when individual choice prevails, each individual has to make active decisions and has to accept responsibility for the consequences (ibid. 1998, pp.36-7; 1999, p.47). Released from collective bonds, individuals gain freedom but with it, they gain uncertainty and risk (ibid. 1991, p.82).

This process does not have to, but can lead to "fragmented" (Helsper 1997) individuals. What this tries to express is a growing confusion of values, beliefs and understanding. Self-integrity, the stabilizing sense of being one and at home in one's body (Stets and Burke 2000, p.34), can more easily get lost. It demands a redefinition of rules by which the individual structures its existence. Castells argues that a more detailed analysis of the "information age" (1996) is necessary, because individuals' networks become increasingly important, and with it the social capital[6] inherent in the network.

21st century's common perception of technology is closely linked to the era's social developments: it is technology that enables the fast development of the new, complex social structures. Additionally, technologies of the late 20th and early 21st

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[6] Social capital, inherent in a network constellation, can be seen as trust, values, norms, networks, organizations, and institutions that funnel the interactions within a society. They are an asset for the individual and collective production of well-being and can affect the performance and development of a society (Sabatini n.d). Of interest for this study is that social capital facilitates certain actions within the structure (Coleman 1988; cited in Hardin 2003, p.1) through shared norms (Putnam 1995; cited in Carpiano 2006). It is also suggested, that trust and trustworthiness within a network rises, when individuals are socially close (Glaeser et al.; cited in Sabatini n.d.).

century permeate deep into all aspects of individuals' lives. A perspective that reflects this impact of technology on various sense experiences is the investigation of "I-technology–world constellations" (Ihde 1990, pp.72-87). This concept analyses the sense-experiences between individuals and technology as ways of engaging with the world.

While this perspective focuses on technology's influence on perception, another perspective, the "script concept" (Verbeek 2006, p.363) is concerned with technology's influence on action. Like a script in a theatre play, technological scripts direct the actions of the actors involved. Consequently, individual actions are in many cases co-shaped by the technologies they use (Latour 1992, 1994; cited in ibid. p.10). Common moral grounds or common self-interest can be sources of legitimisation that make the inscribed action acceptable.

A third form of critically perceiving technology is the combination of perception and action that is mediated by technology. As the new consciousness towards technology has shown, the 21st century's self has become an introspecting, reflective self. Pure technical functionality is a far too limited concept to grasp the possible realities and consequent perceptions with which individuals and groups experience technologies of the 21st century.

What started in high modernity continues: critical perspectives focus on particular technologies and their impact, rather than criticising the overall technical rationality and with it the social system. This approach offers small pockets of criticism and conformity, very much in sync with a modern understanding of democratic individualism and tolerance. However, these new perspectives demand a certain amount of reflection and critical consciousness to be discovered and understood. If members, embedded in a technical-economic organisation, such as design engineers in the mechatronics machinery industry, develop such a critical consciousness remains to be seen.

6.4 Considerations and reflection on the relationship between society and technology

The narrative of social-cultural contexts in various past and present societies discovered a relationship between reality creating, socially imposed conditions and the common perception concerning technology. Furthermore, overall increasing consciousness of the individual self, made emancipation from mono-culturally created realities possible. However, such a critical position requires a high degree of reflection and socio-economic independence, because a reality of technical rationality continues to prevail. Its values and norms dominate the daily economic life in most industrialised countries, and its influence is ubiquitous. This monoculture has developed despite an increased individualism or because of it, and despite a reflexivity that holds the potential to moderate the influence of a mainstream culture. Social realities through the centuries reveal a series of reasons

for this rather unitary, conforming human behaviour that condones a lack of democratic interference and an overall acceptance of technologies bias towards efficiency.

Throughout history, perceptions concerning technology served a purpose: in modernity, rationality that is predominantly biasing knowledge. However, alternative realities became available, and have reached a considerable degree of overall awareness. In a capitalistic oriented society, technology and technical rationality is an effective instrument for achieving immediate well-being. This seems congruent with most people's individual interest. Therefore, it is a very attractive and persuasive alternative in comparison to the tradeoffs required to sustain alternative values. The phenomenon is rooted in the power structure of the late 20th and early 21st century: in modernity's bureaucratic and institutionalised social structure, access to work and education is usually linked to membership in an organisation or institution. These groups or communities are tied together by a shared, usually capitalistic interest. The acceptance of these groups' identities, their cultures, goals, norms and morality is a prerequisite to become a member, which immediately restricts the accepted discourse within the community to a rational capitalistic world-view. While individuals can exercise choice whether or not to join, the individual esteem for well-being seems to overrule other aspects of the self.

Interestingly, technology might offer ways out of this situation. Quickly spreading technologically enabled networks such as the Internet, offer a non-bureaucratic infrastructure for new communities in which to emerge. They constitute new social movements, provide identity, a sense of belonging, and serve as secure bases to engage – even critically - with the outside world (Wellman et al., 2003, approx. p.3). They are usually "partial communities" (ibid. p.2) based on shared interest and shared values and they are not usually tied to a particular place. Individuals today have the choice between various societies and their cultures; they can make up their mind as to which values are most important to them. However, individuals who are strongly embedded in an economic culture might not see a choice and might not need a choice: they might willingly align with a social identity of technical rationalism.

6.5 Information technologies changing inertia on society in the 20/21st century

The following paragraphs investigate the fundamental changes new information technology brings along for the individual and for society as a whole. This viewpoint attempts to uncover sources of enthusiasm or anxiety concerning the technology of the 21st century in the working environment. Attempting to understand the features of the society might create an understanding and a differentiation between individuals who are ready to make changes vs. those who would rather remain within the existing social structure or a structure of the past.

This diversity in an individual's comfort level in different social structures is based on the understanding that there is never a complete and revolutionary change of an entire society at once. Older social models are usually manifested in the social structure and its institutions, and thus they survive for a long time (Castells 1996, p.34). Society as a whole is a potpourri of evolutionary and revolutionary processes of change that slowly alter an entire society, some individuals faster, some slower.

This research offers evidence that society continues to influence human behaviour in the new social topology of an information society, however, the influence becomes increasingly indirect. Individuals' choices of action increase through a growing freedom from social boundaries, at the cost of loss of a clear cultural and moral guidance for action. It is the loss of one uniform social reality and meaning, leaving it up to the individual to find a coherent sense of self. This leads to a fragmentation and a possible destabilisation of existing social identities; the schemes to gain stability and self-integrity change. Technology is an integral part of these changes and therefore, the reaction towards technological change might be inseparable from these changes.

6.5.1 The relationship between society and technology

Societies are organised around human processes; when technology increasingly mediates these processes, social development is increasingly inseparable from this technological infrastructure (Castells 1996, p.14). Societies that used to be organised around bureaucratic and institutional structures, become increasingly organised around technological networks (ibid. p.469). This tight link between social and technological change is reflected in many descriptions of the 21st century and its society: information age, information society, internet society, or computer generation are a few of the most often used terms that reflect the merger between society and its technologies. In essence, when computer-mediated communication networks link people, institutions and knowledge, networks become computer-supported social networks (Wellman 2001, pp.3-4).

Many scholars agree that technology alone did not determine social change (Bell 1973; Drucker 1969; Castells 1996, 1997, 1998), but modernity could only take its course in combination with technology (Johnson and Duberley 2000, p.92). Consequently, technology adoption behaviour in the 21st century is likely to reflect both: societal and technological change. The following literature research will look at technology enabled social changes underway in the 21st century, and the consequences for the individual.

Theories about an information society have been formulated as early as the 1960's and 70's. Leading scholars, such as Daniel Bell (1973) and Peter Drucker (1969; 1964) researched into the phenomena which are compared and differentiated with the more recent work of Manuel Castells (1996, 1997, 1998).

6.5.2 The new quality of technology

One must be aware of a change in the meaning of the term 'technology'. In earlier times, technology and mechanisation were closely tied together. This meaning of technology changed from the 1970's onwards 'high technology', which is primarily electronically and microcircuit enabled information and communication technology.

At the break of the 21st century, there was an ever increasing 'technosation' of all aspects of life, and with medical and genetic technologies, even a technosation of life itself. While the 'industrial' technologies were restricted to certain, mainly work related aspects of life, 'high technologies' tend to penetrate deeply into the user's experience, namely into the very structure how people relate to each other and to the world. Technology is becoming personal and intimate, a dominant aspect in the relation between humans and reality. Technology mediates, which means it transforms or co-shapes many forms of interpersonal communication, and many ways how the world is perceived (Ihde 1990); it co-shapes or transforms action by inviting or inhibiting certain ways of doing something by the material environment (Latour 1992;1994; cited in Verbeek 2006, pp.10-1).

6.5.3 New spatial and temporal meaning

Technologies have always shaped the social reality of time and space, just as time and space have always been closely related to the communication media of a particular time (Innis 1950; cited in Stalder 2006, p.145). Time and space seem to be the stage of life for any society: to make an appointment for communication of any sort, one needs to fix time and space. While Bell and Drucker do not investigate the phenomena, it is central in Castells' (2000, p.14) work. The increase in electronic communication significantly transformed space and time in late modernity. The space of common time-sharing used to be a place in a shared understanding of time, until communication and information technology gradually changed this paradigm (Stalder 2006, p.144).

Most individuals still live and act in a local space, and they usually still operate according to clock time, but due to telecommunication and electronic archiving mechanisms the two functions are no longer necessarily linked through one place. Illustrated in one fictitious example: an individual sits at his computer in London, exercising an online purchase of stock options in Singapore, whose value is directly linked to the predicted amounts of raw oil to be purchased in Rotterdam in 6 month from now.

6.5.3.1 Space

Space is the most structural expression of human culture (Stalder 2006, p.9), but due to new communication technologies and ever faster distribution and travelling infrastructures, societies and individuals lose their traditional sense of place. This equals losing a shared identity (Castells 2004, p.420) and manifests the dissolution of the stability it used to offer. To some extent, place is annihilated through

computer networks: actors need to be in the same space, but no longer in the same place. The context of the immediate location becomes secondary and space becomes increasingly virtual (Castells 1996, p.433), present to those that are connected in a particular network, and non-existent for all others. Electronic networks bring the world to any place, connecting one place with other places, but remain largely independent from any local surroundings (Castells and Ince 2003, p.25). Giddens (1990) calls lifting an individual out of local social relations "disembedding" (p.21). It is up to societies or individuals to create new spatial meaning, which essentially requires new, shared identities. Until such a new identity is gained, it can result in a loss of 'a sense of belonging' for many individuals.

6.5.3.2 Time

Time does not exist in a vacuum or in lifeless nature. The sequence of events at a given place creates time (Stalder 2006, p.155). In this function, it offers an order for experiences (Leipnitz 1715/1716; cited in Klein 2006, p.246). This relationship shows that when the concept of place changes for a society, the concept of time has to be altered also. As Castells (1996) puts it: "time is local" (p.429).

"The clock is not merely a means of keeping track of the hours, but of synchronising the action of men" (Mumford 1935, p.14; cited in Stalder 2006, p.155). If time is the sequence of events then it is crucial for societies to establish a temporal pattern, because then time offers structure and stability to individuals. The breakdown of reliable temporal rhythms for an individual can be experienced on many levels: e.g. many people no longer work nine to five; work time can shift through day and night; it can shift through the year or it can shift between years of excessive workloads and years of unemployment (Stalder 2006, p.158). In the information society, the rhythm of time did not change to a new rhythm, the new time is individualised time, and time is no longer a common nominator amongst members of a society. Time has lost its ability to define a reliable sequence (Stalder 2006, p.157, 160), it is no longer a regionally objective category, and the rhythms of the clock or of nature no longer dominate as a structure in society. One can conclude that "technologically networked individuals" not only lost the embeddedness in a place, they also lost the reliable rhythm of time. For many individuals, this might feel like losing 'a sense of belonging'.

6.5.4 Knowledge

Knowledge and its form of value have been manifested in different ways throughout history. While knowledge was obtained from "doing" in the 17th century, it was related to theories of science after the industrial revolution. In the 20th century, theoretical knowledge was related to practical knowledge and vice versa, aiming for increased productivity. In the 21st century, theoretical knowledge is related to other theoretical knowledge that is related to practice (Drucker 1996, p.455; cited in Steinbicker 2001, p.21). Nano-technology is a good example, where

the theoretical knowledge of quantum physics is applied to the theory of materials technology , resulting in new materials for tooling and production.

As a result of this complex, interlaced relation, one has to have theoretical knowledge in order to develop economically valuable further knowledge; knowledge and information have become the primary resources for information societies' economy (Drucker 1969, pp.455; 60; cited in Steinbicher p.21; Bell 1976; p.163; cited in ibid. p.55); information and knowledge come to the fore of net value added. While all three scholars agree so far, there is a significant difference in the definition of knowledge itself. For Drucker (1969, p.60; cited in ibid.) it is clear that knowledge must be applied to practice to be of value to the socio-economic system, and it is the role of management to organize this knowledge in order to make it productive. While Bell (1976; cited in Steinbicker 2001, p.60) agrees that knowledge becomes the new stratification criteria in society, he argues that codified, theoretical knowledge is most important for the new social value system. This form of knowledge seems most suitable for revolutionary techno-scientific inventions that influence and change society as a whole by initiating paradigm shifts. Drucker focuses on ongoing small inventions within the existing technological paradigm, that keeps the economy as an engine for society steadily going.

In Castells' (2000, p.187; 2004, p.8) line of arguments, knowledge is of no key importance by itself. It is knowledge, in combination with interest and culture, that is valuable and that gives knowledge the power to stratify a society. Interest might be the key to the different definitions of knowledge given here. While Drucker argues from a managerial or capitalistic perspective, Bell focuses at a solution where knowledge supports societies larger goals; a perspective that Rousseau (1753, pp.170-2) 300 years ago dismissed as ideal but unachievable. Castells' position summarises and reflects the distinction between Drucker and Bell's position, by claiming that 'valuable knowledge' is consistent with a society's interest and culture. Specified in this way, knowledge becomes information society's new stratification criteria. A point of agreement is that today's important knowledge is no longer accumulated from doing, but through learning. This new status of learned, theoretical knowledge makes education important, which has consequences. First, since education and access to education is highly institutionalised, bureaucratic structures gain a gatekeeper position. They become empowered to modify social stratification and they are able to enforce social conformity: institutionalised power (Foucault 1972a, p.12).

The second consideration is more complex. Earlier paragraphs of this social perspective investigated social realities, and the argument is that the power to create and change the social order is with those that create and change societies commonly accepted historic and present knowledge (ibid. 1972b, p.211). If knowledge becomes the key stratification criteria, there is a full cycle of self-enforcement of knowledge and power, making significant cultural change less

likely than in a time, when knowledge elites and power elites were not one in the same.

However, knowledge might come with a 'built in solution' for this asymmetric power constellation: knowledge has often a used-up-date and it is usually linked to individuals, so it cannot be passed on to its full extent. There might be institutionalised advantages, such as access to privileged schools or access to information networks; however, individual constitutions, learning abilities and motivation cannot be acquired by purchase or power.

6.5.5 Power

While personal networks were always a factor in the process of elite formation, "they remained, by and large, personal" (Castells and Ince 2003, p.22). They were built around vertical command and control systems (ibid. p.23). In recent times, the national state was the most dominant and legitimate social institution of power, however, the national state comes into crisis when the most significant social sources (economic, social, political, cultural) no longer operate within national borders and when citizens articulate increasingly diverse interests, values and demands for institutional reform (Stadler 2006, p.109).

In the information age, the formal hierarchy of importance dissolves, and a significantly different power structure emerges. Bell, Drucker and Castells agree that the individual share of wealth and power depends on an individual's access to education, knowledge and information, and for society as a whole on the social organisation of knowledge as a productivity factor. For Castells, a network structure of high-speed, high-volume communication and transportation spans the globe. Through this infrastructure, elites produce and process vast amounts of information and individual's actual and potential networked resources define their access to power; the concept of 'social capital' as defined by Woolcock and Narayan (2000; cited in Putnam 2002, p.6).

This constellation has consequences. A person's access to information and its ability to learn define who is 'in' the network and who is 'out'. Individuals and societies who are irrelevant are easily excluded (Castells 1998, pp.364-5), and this exclusion is hardly recognisable by others, because someone excluded from a virtual network is no longer present in the network; not even as an individual at the edge of society like a 'down-and-out under a bridge'. Castells describes the new power constellation as "placeless power and powerless places" (Henderson and Castells 1986, p.7; cited in Stadler 2006, p. 150).

However, the new network topology offers a new dimension for resistance, too. Castells identifies a multitude of "project and resistance societies" that exist in parallel, marking the end of an all-embracing collective (Braga and Menosky 1999; cited in Wellman 2001, approx. p.27). He argues that paradoxically, the logic of dominant, global networks is so pervasive and penetrating that the only way out is the reconstruction of meaning in distinctly different systems of values and beliefs:

the creation of communities with an autonomous social identity. Characteristic for these social movements is that they do not originate within societies institutions; they introduce an autonomous, alternative social logic (Castells 1998, p.371). They offer distinct group- or role-identities for individuals: religious fundamentalism or ethnic separatism are examples of such resistance identities, that break with society at large, drawing a clear line between 'who we are' versus those 'who do not belong' (ibid., pp.371-2). Even more common are interest driven project centric communities. Individuals can be members in several interest groups, each one covering a specific, fragmented aspect of live. "Each person sups from many tables, but experiences only a single banquet of life" (Rees-Nishio 2001; cited in Wellman 2001), in other words, it is up to each individual to make a whole out of the sum all social identities he or she holds. For Castells, the battles between these different communities and their cultures are the power battles of information age and therefore, power and culture becomes dynamic. This constant instability of power and culture reasons that network societies face a gap between the technological over-development of flexible, dynamic structures and a social underdevelopment due to this flexibility and speed (Castells 1998, p.379).

This emerging fluid power constellation brings new challenges for the individual: the constant risk of losing power and the constant possibility to acquire power are sources for increased anxiety and stress for any individual or group in a powerful function, which translates one-to-one into shorter life expectations and unhappiness. According to recent research, a happy and long life is life among equals, in friendship and solidarity (Ingelhart and Klingmann 2000; Argyle and Li 1990; cited in Klein 2002, p.172, 261).

Castells' theory of power is criticised for being linked to a person exercising power over another person, and does not explain how power operates in the absence of a person and in a bi-directional or multi-directional way. Which is, as Stalder (2006, p.130) argues, the very characteristic of a network structure.

6.5.6 Technology, economy and work
According to the authors, the economy of the 21st century is characterised by two main factors: the transition to a world economy with a globally unified technological infrastructure, and its consequences for the economic culture on a macro-, messa-, and mirco-level. Capitalism and economic risk both gain a new quality and the shift of knowledge and information as a primary source for productivity, efficiency and competitiveness change organisational structures and the working environment. These changes bring along a series of positive and negative consequences that will get unpacked, based on Castells' and Drucker's thoughts; Bell does not focus on the economy in isolation.

The 21st century's economic transition to a world economy is deeply bound with the global spread of similar communication and information technology that synchronises processes in historically very different businesses and cultures (Castells 1996, p.106). The new, unified economic structure connects organisations

and encourages a unified economic culture (Drucker 1969 p.103, 192; cited in Steinbicker 2001, pp.24-5; Giddens 1989, p.51). Existing structures and processes become either reorganized into new patterns, for example from national to trans-national production, or repositioned vis-à-vis a new highly productive structure. What differentiates the new global economy from the world economy of previous ages is that "it is an economy with the capacity to work as a unit in real time on a planetary scale" (Castells 1996, p.92), and it becomes increasingly independent from its local social context by developing a global social context of its own. Rather than creating the same conditions everywhere, the global economy is interdependent, asymmetric and it operates on a selective in- and exclusiveness. As a result, it has an extraordinarily variable geometry that tends to dissolve any historic, economic geography (ibid. 1996, p.106). Today, the global economy is concentrated in relatively few places, such as the financial centres of the world or the development zones in southern China.

The most distinct result is the emergence of what Castells calls the "space of flows" (ibid. p.433): an integrated, global, technology enabled network that links various networks of capital, labour, information, and markets, as well as valuable functions, people, and localities around the world. Simultaneously, the network switches off those populations and territories "deprived of value and interest for the dynamics of global capitalism" (ibid. 1998, p.357).

6.5.6.1 Technologies transforming effects on the economy

Information in its broadest sense has been critical in all societies, however, technology enabled information generation, processing, and transmission of the 21st century becomes the primary source for productivity, efficiency and competitiveness and thus of economic power. For the first time in history, the human mind is more than a decisive element in the production system, it is a direct productive force, and computers, communication systems etc. are amplifiers and extensions of it (Castells 1996, p.32). The consequence is the mediating and transforming influence of technology in all aspects of the economy. The most critical production factors, knowledge and information, are processed and communicated by an increasingly global and uniform technological infrastructure that shapes economic culture and which puts technology in a forefront function of shaping what counts as real in the economy.

On a macro-level, technology enables the transformation to a new logic of a network economy, which has become most apparent in the financial sector and which seems to feed a loop of self-acceleration. The changing power constellations between labour, knowledge work, management and owners influence the power dynamics of a society as a whole. They become increasingly dynamic and interest based, a collaborative culture replaces cohesion and tradition. Since knowledge and information usually have a short term value only, they often get traded in dynamic, personal networks (Rayman-Baccus 2003, p.183), consequently, economic power structures are in constant flux, a characteristic of a collaborative, networked

economy. On a micro-level, technology changes most individuals' immediate work environment, co-shaping and changing their work and communication processes. Stabil work processes are increasingly replaced by project work; formal hierarchies and job definitions become less important; the ability to adjust to new situations and to acquire new knowledge becomes an increasingly valued attribute (Drucker 1993, p.39; cited in Steinbicker 2001, p.39).

Work processes and the experience inherent in work is further modified through technologies' changing effect on the sensory relationship to other individuals, machines or materials; as mentioned before these experiences are reduced from what used to be holistic experiences (Ihde 1990, pp.72-112) to one-dimensional ones. Unfortunately, for the working individual, recent research suggests that holistic experiences matter, face-to-face relationships matter and physical place matters (Wellmann 2001, p.23). Even cyber-space workers, who tend to switch companies fast, like to concentrate in particular areas such as Silicon Valley or Boston, USA.

This reduced experience is particularly unfortunate, because humans interact increasingly with humans instead of machines (Bell 1976, p.163; cited in Steinbicker 2001, p.55), and some even argue that the company-centric economy transforms to a people-driven one (Florida; cited in Wellmann 2001, p.23). This leads to the paradox that while value generation depends increasingly on a human-to-human communication that goes like clockwork, the physical distance between humans rises. There is also a transition in the relationship between work, its processes and private lives. Instant messaging and constant wireless LAN availability are only two examples that have direct consequences for working routines of individuals: their sense of privacy and other peoples' expectations about their accessibility change.

While all these changes are significant, former socio-economic models are still present (Wetterstein 1995; Douglas 1982a; both cited in Rayman-Bachus 2003), because the social structure of past cultures can prevail for a long time and not all local economies are equally influenced by the changes described. Some industries and organisations continue to operate by the structures of previous economic cultures, or they are migrating partially. The German mechatronics machinery industry has traditionally been a conservative industry, slow in adapting to organisational trends. However, international competitive pressure has turned them all into global players over the last 5 years.

6.5.6.2 A new form of capitalism

Thanks to globally operating economic networks, the whole world is organized around one unified economic culture and a largely common set of economic rules. Agreeing to these basic rules, and equipped with a fast technological infrastructure, the economy becomes a very efficient, complex community, based on a modified culture of capitalism, much more flexible than its predecessors, much more complex, and its new assets are knowledge and information.

Drucker, Bell and Castells agree on the significance of the changes but theyvary in the consequences. Both Bell and Drucker expected a moral turn in economic culture in their earlier works. Bell predicted a warfare state instead of intensified capitalism, where moral and ethical responsibility in organisations sets a border line to efficiency goals (Bell 1976, p.298; cited in Steinbicher 2001, p.63). Some early work of Drucker (1939; cited in Wikipedia "Peter Drucker") also emphasises the need for community, and the social responsibility of companies. For both Bell and Drucker, organisations are communities integrated within the context of a larger social order. Thirty years after Drucker and Bell, Castells (2000, pp.210-5) criticises the outcomes of an explicitly networked economy, where hard and honest work no longer ensures well being. The increasingly gamble-like character of the financial markets create and destroy wealth at random, in no relation to production and work. A small cause might result in a huge economic effect, and a huge cause might go almost unnoticed; typical features of a complex system. For Drucker and Castells, the new economy and its organisations have become the master clock for society, its culture and any associated moral and value. This new culture is a hardened form of capitalism in its goals, but it is more flexible than any of its predecessors. It is an informational capitalism, relying on innovation-induced productivity, and globalisation oriented competitiveness to generate wealth, and to appropriate it selectively. The new capitalism is increasingly embedded in culture, thus influencing the entire society.

6.5.6.3 Economic risk

The consequences of the non-linear effects of the complex economic network between capital, the network of management, and information technology are felt in economies and daily lives around the world:

> *... recurrent monetary crises, ushering in an era of structural economic instability and actually jeopardizing European integration; the inability of capital investment to anticipate the future, thus undermining incentives for productive investment; the wrecking of companies, and of their jobs, regardless of performance because of sudden, unforeseen changes in the financial environment in which they operate; the increasing gap between profits in the production of goods and services and rents generated in the sphere of circulation, thus shifting an increasing share of world savings to financial gambling; the growing risks for pension funds and private insurance liabilities, thus introducing a question mark into the hard-bought security of working people around the world; the dependence of entire economies, and particularly those of developing countries, on movements of capital largely determined by subjective perception and speculative turbulence; the destruction in the collective experience of societies of the deferred-gratification pattern of behaviour, in favour of the "quick buck" common ideology, emphasizing individual*

> *gambling with life and the economy; and the fundamental damage to*
> *the social perception of the correspondence between production and*
> *reward, work and meaning, ethics and wealth.   Castells 1996, p.436*

Because of this changing society, individuals are confronted with a significantly changing economic reality. Everything that was believed to make life predictable and stable changes, leaving individuals with a series of choices and options they never had before, but with no means to predict the future outcome. In a complex technologically networked society, fate and luck paradoxically seem to become reviving phenomena.

Active, 'calculated' risk taking has become a positive economic attribute because opportunity and innovation are the positive sites of risk (Giddens 1999, p.35). Due to the complex global network structure, the multitude of unintended positive or negative consequences of action bring along a diversity of new situations that cannot be brought under human control with rational risk-management. Paradoxically, the rationality of the new networked capitalism demands trust to overcome risk (Beck; cited in Misztal 1996, p.2). Hardt (1988, p.191; cited in ibid., p.3) goes as far as claiming that trust becomes central to social life when neither traditional certainties nor modern probabilities hold. Unfortunately, it does not yet seem clear on what basis this trust could grow.

6.5.6.4 Organisational structures

Drucker and Castells both cover organisational changes in their analysis of the information society, but each one has a different focus. Drucker analyses the changes from an economic and management oriented perspective, with a focus on the micro level within an organisation. Castells' interest is the social change and the new dynamics of power and interest in a networked world society, focusing more on a missal and macro perspective. A managerial perspective vs. a humanistic one, are both based on the same cultural assumption: in management theory, productivity essentially stems from innovation (Kast and Rosenzweig, 1970, p.221; Schumpeter 1942, p.84; both cited in Baaij et al. 2004, p.519), competitiveness from flexibility (Castells 1998, p.361). Thus, it is not surprising that economic units of all kinds align their production relationships to maximize innovation and flexibility. The cultural capacity to use information technology is the second significantly new factor. These changes bring innovation, flexibility and people management to the forefront of new management strategies and organisational structures. A common denominator for both Drucker and Castells is that organisations become increasingly organised around technologies. No longer is only the production processes technologically mediated, increasingly it is the entire information flow that follows the logic of their enabling technologies.

6.5.6.5 Technology and the transformation of work

To complete the analysis of information technologies change inertia on the economy and the economy driven social value system, the transformation of work

needs scrutiny. When social value becomes increasingly defined through contributions to the economy, and when knowledge and information are the essential materials of the new production process, whoever is educated can reprogram oneself toward the endlessly changing tasks of the new production process (ibid. p.345). Learning and re-learning are the "survival skills in the flexible world of information capitalism" (ibid. p.361). On the other hand, generic labour with no reprogramming capability is essentially replaceable by automation or by other labour. The industrial worker becomes peripheral to the economy; this labour is no longer of core relevance. This new differentiation between two forms of labour mark a significant change in the information society as referred to by both Drucker and Castells. For Drucker, labour no longer relies on experience, but on the ability to acquire knowledge; and this is no longer knowledge through experience but knowledge through learning (Drucker 1969, p.359; cited in Steinbicker 2001, p.31).

Besides the significant changes in learning, the fact that knowledge is typically linked to individuals revolutionises the relationship between knowledge workers and organisations: increased self-organisation and self-control are among the most significant changes (Castells, 1998, p.361). Knowledge workers have expectations not known before, and sometimes not in line with an organisation's reality. Since knowledge workers are specialists in their genre, they often know more in their field of expertise than management. Tasks and projects are often handled most efficiently in flexibly configured teams. Consequently, it is knowledge and task relevance rather than name, position or age that becomes important (Steinbicker 2001, p.34). These changes changed the employment relationship that led to Drucker's theory of management by objectives which was built on the understanding that traditional disciplinary management of labour does not fit the new production system. Castells (1996, p.437) modified this concept further: skilled labour is required to manage its own time in a flexible manner, sometimes adding more work time, sometimes reducing working hours and pay. In its extreme, the flexible management system of networked production relies on a flexible temporality, on the ability to accelerate or slow down product and profit cycles, on the time-sharing of equipment and personnel, and on the control of time lags of available technology vis-à-vis the competition (Castells 1996, p.439). Castells analysed the situation 30 years after Drucker's analysis, where 'networkers' and 'flextimers' increasingly replaced the full-time employee. Work became "self-programmable" and highly productive. According to Castells, the pervasiveness of this individualization of work and the flexible and unstable patterns of employment undermined the collective identification of labour (Castells 1998, p.364).

Furthermore, the loss of a stable relationship of employment and the weak bargaining power of many industrial workers led to crises in the life of many individuals and their families. Access to work becomes a key criterion for social stratification, excluding all those that are unable to constantly update their skills (ibid., pp.364-5). European societies are in deep debate where the emerging society

should be positioned: between a Darwinian approach of the survival of the fittest or a humanistic, a solidarity based approach, carried over into the information era from the warfare systems of the late industrial era.

6.5.7 The emerging of a network culture

> *Computer networks have become social networks.*
> *Wellman 2001, approx. p.2*

The previous paragraphs suggested changes in almost all aspects of individuals' lives; and no one seems to remain unaffected. Since culture is "the way of life for an entire society" (Jary and Jary 1991), Drucker, Bell and Castells agree that the value of knowledge and information changed so significantly over the last three or four decades, that a new social value system emerged. Both Bell and Castells addressed such an overall changing social frame in their work.

Bell saw a paradigm shift from the historically rooted "protestant ethic" (Weber 1905) to mass production and mass consumption with hedonistic tendencies, resulting in an "attitude of cape diem, prodigality and display and the compulsive search for play" (Bell 1976a, p.477; cited in Steinbicker 2001, p.64). It is the lack of a moral belief system that creates a cultural contradiction for society (ibid., p.65), resulting in a disjunction between culture and social structure. In this case, bureaucracy and sanctions have to glue society together, which is a development towards an impersonal, secondary linked society, rather than a society based on collective ethics. Such a gap between the individual interest and what social reality understands to be good for society as a whole is an indicator for a period of social change; a phenomena that has already been identified by Rousseau (1762, bk.2, ch.3,4).

A disjunction between culture and social structure is a phenomena that Castells also identifies. He brings forward different reasons: the structural transformation of space and time, which have been closely linked with peoples' traditional cultures, require a change in culture. A new technological infrastructure does not make a new culture and what is necessary for individuals to communicate, is a common code, a shared meaning. In order for a new cultural code to emerge, a new shared understanding is necessary (Stalder 2006, p.90; 189). For Castells, such meaning is expressed through socially shared identity. "Identities are sources of meaning for the actors themselves, constructed through a process of individuation" (Giddens 1991; cited in Castells 2004, p.7). In Castells view, these identities are expressed through social movements, and each one, successful or not, changes culture and society a little.

Castells distinguished between three relevant forms of social identity. The legitimising identity generates and defines the civil society and reproduces the status quo. It is institutionalised in organisations and institutions and represents the mainstream culture in a stable social environment. When enough people recognize themselves in this culture, and accept the institutions that represent it, this identity

is unchallenged in a democratic environment (Castells 2004, p 8). Groups that resist the dominant culture, its institutions and values develop a "resistance identity" (ibid.). They are those to whom the existing society has nothing positive to offer. Another form is a "project identity" (ibid.). Their advocates aim to change society in order to find a place in it.

The ethical foundation of Castells' information society is not one new culture in the traditional sense, because the diversity of networks reject one unifying 'network culture'. It is a common cultural code made up of many cultures, many values, and many projects. Its ethical foundation changes at the same pace as the networks' members and structure changes (Castells 1996, p.199). It becomes a multifaceted, virtual culture.

The new non-linear capitalism has become a new social reality for many societies; a shared understanding that might serve as a bases for consensus and cooperation in the economy and in many areas of society, but as the previous paragraphs have outlined, it is a culture of selectively chosen social solidarity. It is solidarity with those that share a similar interest and that can contribute to this interest; a form of solidarity that has little to do with the historic solidarity with weaker members of a society. This new form of solidarity purposefully excludes some groups from the form of social cohesion presented.

Castells (1996) further theorises that a network culture is a culture of "creative destruction" (p.199); a move away from a mechanistic, linear Newtonian and neo-Darwinian causality to a complexity perspective (Stacey 1997, p.1; Stalder 2006, p.171), that displays complex chaotic patterns of behaviour. They are not proportional to their multiple causes, and cannot be predicted (Fitzgerald 2002b; cited in Burns, p.78). Castells might not go as far as Capra (2002) or Stacey (1997), who argue that social organisations are living entities; for him, a network does not represent the environment, but each network has its own world. They not only create and reproduce themselves, but they also create their own coupling with the environment. The environment is constituted by the network and not the other way around (Stalder 2006, p.192). The global financial market is an obvious example. It does not represent global trade or production, but follows its own dynamic, based on just a few rules and completely independent from the "real" economy. It incorporates information from the outside selectively and unpredictably and it seriously affects its environment in the same manner. Consequently, the social identity of a network node is determined by the network's identity, which is determined by the entire network – a rather dynamic, complex and uncontrollable way of determining an identity.

6.5.8 Reflecting on socio-technical changes of the 21st century
Grounded in the close interrelation between technological and social change, it has become obvious that technological change is much more than a modified work routine or process. Technological change is usually embedded in a mechanistic, technological rationality, it is closely related to cultural change and it brings along

confusing identity choices. In short, technological change is related to the breakdown of what has long been understood as a given social reality, while a new one has yet to develop for many individuals.

Considering networked societies, 'connectedness' or 'embeddedness' depends on at least two factors: the first is concerned with shared understanding, the second with an understanding for the borders of one's network.

It has been pointed out, that what is sent and what is received in network communication is subject to interpretation, and it requires a shared cultural framework to receive what was send. There are multiple world spanning networks, and even more, smaller networks, and each one has its own culture, its own interpretation code. Even when nodes might exist in the same place, perhaps with two individuals who work desk to desk in an office; they might not share a common culture and they might be unable to communicate on a shared level of meaning on many aspects. A disjunction between culture and social structure, as Bell (1973, p.480) pointed out: the lack of a common culture and a common morality within a given social structure.

The second point considers power and the awareness structure in a network: those nodes that absorb more information and process it more efficiently increase their importance in the network. Thus relative importance of nodes does not stem from their specific features, but from their ability to contribute valuable information (Castells 2000, p.187). If a node contributes nothing or negative value, the network reconstitutes itself without that node. The network logic is an in/out logic. The power of social exclusion was present in all societies; what is new in this network logic is the speed and ease with which this can happen. The boundaries in a binary world are strict and humanity is easily expelled. Thus, anxiety and pressure to function within the chosen network are likely to increase, in order to not be expelled: it is the constant fear of having a job vs. not having a job; demonstrating the adequate skill set vs. not demonstrating it; demonstrating an adequate lifestyle vs. not demonstrating it; belonging to the winners or being a looser. It is not realistic to say that there is nothing in-between; however, the spectrum for a middle ground becomes thinner. A polarisation in the social world that is likely to bring about an increased polarisation of the social self.

Group-based vs. Network-based Societies

Group-based Society	Networked Society
United Family	Serial Marriage, Mixed Custody
Shared Community	Multiple, Partial Personal Nets
Neighborhoods	Dispersed Networks
Voluntary Organizations	Informal Leisure
Face-to-Face	Computer-Mediated Communication
Spaces	Public Private Spaces
Focused Work Unit	Networked Organizations
Job in a Company	Career in a Profession
Autarky	Outsourcing
Office, Factory	Airplane, Internet, Cellphone
Ascription	Achievement
Hierarchies	Matrix Management
Conglomerates	Virtual Organizations/Alliances
Cold War Blocs	Fluid, Transitory Alliances

Table 5: Group based vs. networked societies

To recap the differences, Table 5 contrasts group based societies with networked societies, according to Wellman (n.d.).

In a hierarchy, the whole defines the parts, and each part understands its roles and groups by looking at the whole. In a market structure, the parts define the whole and each part's identity remains intact. In a network structure, the node and the network define each other. If each part has an individual identity and the whole has one or more social identities, and they flexibly constitute each other, a situation of stability cannot be achieved, because the system in constant change. Long term instability and short term stability through change seems to be a feature of a network structure.

Additionally, each network has its own values and codes, its own culture. While there might be a dominant capitalistic culture in the institutional and economic base of many current societies, there is also an increasing amount of parallel societies that operate on a large scale. Maybe one should talk about a dynamic meta-culture of instability emerging from a network culture where 'the only stable element is the change'.

Since no traditional or cohesive relationship glues 21st century societies together, collaborative patterns are increasing. They do not require solidarity, they are embedded in a culture of toleration and a common interest is the basis for any relationship (Wellmann 2001, approx. p.3). Abstract bureaucratic and legal rules magnify the trend and moral affection becomes increasingly obsolete and rare (Seligman 1992, p.126; cited in Misztal 1996, p.209). There is growing individual

control over one's own life (Wellman 2001, approx. p.3) and one's embeddedness in society. Individuals can withdraw from larger society into smaller, often computer supported communities (Misztal 1993, p.210). These new communities have nothing to do with the historic aim "of transcending the self through identification with a class, group or nation." (ibid.). It is rather to recover strong expressive selves, to make "thin" selves "thick" (Rosenblum 1989, p.218; cited in ibid.) – a necessary development when social identity at large is fragmented and diversified and does no longer offer the stability and security it used to offer.

This is necessary because the destabilizing factors for the self have significantly increased. Rationality is no longer a reliable frame of reference; a new logic of causal development emerges. A new special and temporal meaning develops, dissolving embedment in a place, as well as the reliable rhythms of time. A new binary logic of stratification bears the risk of complete exclusion. Status and prestige are linked to the ability to learn and re-learn. Those that do not have the capacity or the infrastructure to keep up with lifelong learning lose their place in the network society.

7. Organisational Perspective

7.1 Introduction and chapter overview

Further understanding the impact of organisations and groups within organisations on technology acceptance behaviour is important. Organisation specific structures might be a source for organisation related social identities, relevant for the investigation of technology acceptance behaviour. This chapter investigates typical social and personal identities within the working environment, and it introduces the mechatronics industry sector as a newly emerging industry.

The analysis of human behaviour indicated that the institutional influence on individual behaviour can be significant. Many of those influences have been discussed in the previous social chapter. Organisations can be seen as "micro societies" (Handy 1999, p.9) just as the largest one of all organisations is society (Schein 1970, p.8). Hence, the previous discussion of mechanisms of social influence all apply to organisations: there are changing social realities, power, authority, bureaucracy, belonging, habit, routine, rationality, etc.; all of which play a role in societies, including those that are more explicit and formal such as business organisations. In what sense they are more explicit and formal and what consequences this has on human behaviour is subject of this chapter.

All social structures addressed in this organisational perspective are based on the assumption that human behaviour is influenced by a shared reality that is beyond the individual, subjective interpretation. The purpose of this chapter is to further understand these socially shared, recognisable structures' influence on individual technology adoption.

A definition of organisations and their cultures will set the frame to scrutinize the processes of institutionalisation and internalisation as the source for organisational cultures. Tacit organisational and professional knowledge will be investigated, along with their relationship to formal and informal groups, such as professions and academic disciplines. The professional structure of the mechatronics industry sector is mapped out in order to deepen the understanding for this new discipline, and the concept of career anchors as professional career identities are discussed.

7.2 Organisational cultures

This section defines organisations, illustrates how and why organisational cultures develop, and offers a typology for the content of these cultures, that might enhance the understanding in this research.

7.2.1 Definition of an organisation

The idea for organisations stems from the same source that started societies: an individual alone is not able to fulfil all of his or her needs and wishes, because he or she lacks the ability, strength, time or endurance required. Therefore, an individual must rely on a coordinated effort with others in order to fulfil his or her needs (Schein 1970, p.8). However, in order for coordination to be helpful, common goals and some agreement concerning the achievement of these goals must exist. Furthermore, Schein (ibid., pp.115-6) states some propositions: one, organisations are open systems, in constant interaction with their environment. Two, the organisation is a system of multiple purposes and functions that involve multiple interactions. Three, the organisation consists of multiple, dynamically interacting subsystems. Four, the organisation exists in a dynamic environment of other, larger and smaller systems, and five, the multiple links between the organisation and its environment make it difficult to define clear boundaries.

7.2.2 Formal organisations

There are different kinds of organisations, and the definition offered above is what sociologists call "formal organisations" (ibid., p.10). They differ from social organisations that have more spontaneous patterns of coordination, and from informal organisations that refer to the patterns of organisations that arise among some or all members of a formal organisation, that are informal and that follow their own rules (ibid., pp.10-1).

7.2.3 Definition of organisational culture

> *Organisational culture is the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.*   *Schein 1984, p.3*

Later, Schein added that they operate unconsciously and define an organisation's view of itself and its environment in a "taken-for-granted" fashion (p.6; cited in Johnson and Scholes 2002, p.45). Thus, they represent an organisation's pattern of shared values, beliefs, goals, needs and morality, and they produce certain norms of behaviour (Osland et al., p.320).

7.2.4 The development of organisational cultures

Borrowing the process steps from the People Capability Maturing Model (P-CMM) (Curtis et al., 2002), which describes the various different stages of the "maturing" of an organisation and its members, the development, institutionalisation and internalisation of organisational or group cultures can be described and differentiated.

Starting as a new organization, there is usually no consistent way of performing work (Curtis et al. 2002, p.9) other than the processes and practices in which

individuals have been trained and educated (Becher 1989, pp.19-20). Many work processes are ad hoc, are constantly reinvented, and frequently appear chaotic. Typical work processes and their results are described as people constantly rushing about to achieve overly aggressive deadlines, cutting corners, making time consuming and costly mistakes from hasty work. From a motivational perspective, entrepreneurs who usually drive such start-up phases, have vision, energy, a strong desire to succeed, and consequently creativity and moral are usually high (Osland et al. 2001, p.318). When resources (people, equipment, technologies, cash, suppliers, etc.) define abilities, and no established processes, procedures, or values limit organisational action, organisations can respond flexibly and adapt to market shifts and new, promising ideas (Christensen and Overdorf 2000, pp.103-4;116-7).

Such an organisational culture is typically embedded in one of two different managerial styles: there can be a personal power centre, (Handy 1999, p.183), which is flexible and fast, proud and strong, yet highly dependable on the character of the individual or the few individuals at the centre. The second style is grounded in an entirely democratic structure, with power distributed to all members and self-control being the predominant form of power. Such highly individualistic organisational cultures can be described as a "personal culture" (ibid., p.189).

With an increasing level of majority and growth, organizations establish a more stable foundation (Curtis et al., 2002, p.9). The division of labour, communication and control are still likely to be informal (Osland et al., 2001, p.318) but there is some form of basic management control over daily work, and some organization-wide practices have a chance of successful deployment. The primary objective is to enable people to repeat practices they have used successfully in the past. To enable this repeatability, a more directive management style is needed, a "task culture" (Handy1999, p.187), which focuses on "getting the job done". A strong work team structure attempts to bring together the appropriate resources while members still identify with the organisational mission.

Further development leads to a formalisation stage, "where the organization identifies its best practices and integrates them into a common process" (Curtis et al. 2001, p.10). Here people are able to perform their work at a repeatable level, using practices they have found to work, and the organization has the ability to identify which practices work best in its unique environment. "At this point, organisations seem to realize the emergence of a common culture[7]" (ibid.), a culture based on the institutionalisation of common professional practices and common beliefs about the effectiveness of these practices, but the bonding excitement about the mission of the organisation may start to disappear (Osland et al. 2001, p.319). Over time and through increased success, this culture becomes

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[7] In contrast to other classification perspectives on organisational cultures, this emerging "common cultures" refer to the ideologies of how to go about work.

internalised, subconscious, tacit knowledge. In a management style nomenclature, such cultures still fit the characteristics of a "task culture" or the increasing structure assembles a "role culture", where rules and procedures are manifested in a bureaucratic system to ensure reliable, consistent and orderly performance (Handy 1999, p.185). Such cultures are predictable and stable; habit and routine are valued; communication has become formal and long-term planning is common (Osland et al. 2001, p.319). Consequently, these organisations are inflexible and slow when they need new capabilities. New processes that often accompany new technologies have to overcome individual reluctance, but furthermore, the entire organisational value system must change. Some scholars (Christensen and Overdorf 2000, p.116-7) suggest that in order to implement technological change in such organisations, new organisational space should be created, outside existing cultures. Only then can new values and new capabilities develop.

7.2.4.1 Critical discussion

The P-CMM offers a framework to explain the institutionalisation and the internalisation of knowledge and processes within organisations and groups, independent of their focus. The original purpose of the model is the continuous improvement of a business organization's workforce and thus the model has a clear efficiency bias. The author cautions that any one of the stages of organizational cultures mentioned has its advantages and disadvantages. There is no one formula for 'the best organisational culture', and as Handy (1999) concludes: "more modern theories of organisation are increasingly persuaded of the wisdom of the appropriate" (p.181). All cultural forms are especially good at doing some things and have their deficits elsewhere. The following paragraphs characterise organisational cultures further.

7.2.5 Categories for organisational cultures

The many possibilities to segment organisational structures give inspiration for factors that can influence the perception about an organisation's culture. In this research study, legitimization of authority, methods of influence and the predominant organisational task are selected to describe an organisational structure further. The factors that prevail as culture are unique for each organisation.

7.2.5.1 Legitimization of authority

Organisations usually coordinate their various functions through some kind of hierarchy of authority. In order for this coordination to work, especially within a business organisation, individuals must obey some directives and rules and must contain their own inclinations. Authority is not the same as pure power, since it implies "the willingness on the part of the "subordinate" to obey because he or she consents, that is, he [or she] grants to the person in authority or to the law the right to dictate him [or her]." (Schein 1970, p.13). In order for authority to influence a commonly perceived culture, there has to be a shared consent among most of its members.

The pattern of authority depends in part on this consent. The segmentation in rational, traditional and charismatic authority (Weber 1947) is classical. Charismatic authority means that individuals are personally devoted to a "gifted" leader (Kilcullen 1996). Traditional authority functions out of habit and routine or some form of accepted higher order. Rational authority is understood as the 'rule of law', and it exists in communities in which there is a moral attitude of respect for the law. This segmentation is dominated by the texture of power and where it resides.

7.2.5.2 Methods of influence

Another important aspect that can shape culture is the method of influence primarily used in an organisation. This is based on the "psychological contract" between the members of an organisation and the organisation. This contract can be described as the individuals' perception of what the organisation gives to them and what influence they have on the organisation (Schein 1970, p.13).

There are methods that are overt and others that are unseen. They range from open and crude force, over exchange, rules and procedures all the way to persuasion (Handy 1999, p.133). Unseen methods of influence include environmental control, where by means of controlling the environment, such as incentives or mobbing, influence is practiced. Another invisible method of influence is the often-unexplainable attraction of an individual (ibid. 139), to whom others gravitate.

7.2.5.3 Organisational structure and task

Certain organizational tasks have a higher affinity to some kind of cultures than others do. Therefore, cultures also depend on the primary tasks of an organisation. The tasks again are related to the primary objectives; these tasks and their related objectives can be differentiated using the majority stages of organisations and their members, described earlier: innovation, crisis, steady state, and policy (Handy 1999, pp.201-2).

A simple, entrepreneurial setting is centralised vertically and horizontally with direct supervision. A machine bureaucracy relies on standardization of work processes, and a professional bureaucracy relies on a standardisation of skills and knowledge at its core, and is vertically and horizontally decentralised. The divisional form standardises on output, an adhocracy is a project organization, that coordinates itself by mutual adjustment; a missionary form is based on ideologies; and a political form practices control based on forming alliances. In brief, a conclusion can be drawn that the common agreement on the primary objective and its related tasks as the majority of organisation members perceive them, seems to strongly influence what its members perceive as appropriate or not.

7.2.6 Interpretation structure for organisational cultures

The aspects selected in this organisational perspective are supposed to create a common reality within an organisation that escapes the subjective interpretation of the individual. The list is not exclusive and other aspects might apply, but the ones

mentioned are most commonly found in organisational literature. Cultures are perceived, rather than defined, and therefore, there is always variation in their interpretation. It is the atmosphere, the way of doing things, the level of energy, the individual freedom and the kind of personalities that altogether form the perception (Handy 1999, p.180).

Handy's (1999, pp 183-91) categorisation of cultures as power culture, role culture, task culture and personal culture merges the various categories mentioned, into coherent 'culture-packages' that promise to serve as a simplified typology of reality.

Table 6 lists characteristics that he grouped together into 'typically perceived' forms of corporate cultures:

7.2.6.1 Four forms of corporate culture

Table 6: Corporate cultures; Table content extracted from Handy (1999, pp.183-91).

	Power Culture	**Role Culture**	**Task Culture**	**Person Culture**
Structure	Spider's web	Greek temple	Net or matrix	Cluster or galaxy
Typical Environment	Small, entrepreneurial organisation	Stable, multi divisional corporations	Fast changing environment (e.g. IT)	Partnerships, (network of freelancers)
Culture	Central, charismatic power source; min. org. structure; effectiveness through trust + empathy; takes pride in results; cohesive ties.	Role and procedure driven; logic + ratio. oriented; organisation represents set of roles; orderly; logically org. for effectiveness. Reliable culture, takes pride in process.	Team culture; job or project oriented; "getting the job done"; takes pride in teamwork and results.	The individual is the central point; takes pride in individual skills and freedom.
Management and regulative principle	**Personal charisma and persuasion of central person,** not by command; control exercised by personal selection of key individuals; few rules, procedures, + bureaucracy; faith in individuals, little in committees. Political organisation.	**Rules and procedures for roles**, communication + conflict mgmt. coord. by narrow band of senior managers. When jobs are done as laid down, the result will be as planned; job description more important than individual who fills it.	**Joining appropriate resources and people**; task forces+ project teams for special purposes; teams are obsolete, reformed, or contin. depend. on new task; decision making power within team; respect and working relationship based on capacity, not age or status.	**Minimal structure** or organisation is to serve the individual within; no super-ordinate objective; **collaborative**; no control mechanisms + no management hierarchy; little allegiance to organisation.
Power base	**Resource power** is power base; personal power at the centre.	**Position power**; personal power is frowned upon; expert power is tolerated in its proper place.	**Expert power** but position and personal power have their effect. Self-control over own work.	**Personal power** is possible but individ. are hard to impress. Self-control over own work.
Necessary for success	Right judgement at the centre.	Appropriate handbook with rules and proced.	Skills and knowledge of teams.	Skills and knowledge of individuals.
Measure	Judgement by results; tolerance of means.	Judgement by satisfactory role performance.	Judgements by results.	Judgement by individual results.
Strength	Cohesive ties; flexible, dynamic, fast organisation. Proud and strong in flexible environment; very competitive.	Predictability: strong in function+ special.; routine + habit; strong in stable environm. + economies of scale;	Extremely adaptable and fast, thus very competitive.	Expertise of individuals; freedom.
Weakness	Dependence on dominance and character at centre; can't handle size; unpredictability and uncertainty.	Inflexibility: too much stability, routine + habit.	Suppression of individ. object.; status and style differences; hard to find economies of scale + depth of expertise; control is difficult.	No economies of scale; rather unpredictable and unstable, maybe chaotic.

7.2.6.2 Discussion and evaluation

The organisational structure and the patterns of authority and influence are strong indicators as to "how things get done around here", and what atmosphere dominates. These factors might be important to shape group identity. Handy's culture categories pay attention to these factors and his stratification seems to fit for the mechatronics machinery industry, investigated here. However, he gives limited attention to groups of individuals within the organisation and their "predominant way of perceiving and doing things" – one could talk of discipline or profession specific cultures, originating in the predominant disciplines and market specifics. The following paragraph will discuss these aspects.

7.3 Groups within organisations

Individuals at work are usually organised by their roles, tasks and capabilities into groups within an organisational structure. In a business organisation, the profession and specialisation qualify a particular individual as a member of a work team or group. There is ample evidence that groups have a major impact on their members, on other groups and on the host organisation (Schein 1970, p.81). This paragraph will focus particularly on professional groups and on work group influences.

7.3.1 Characteristics of groups

A group is any collection of people who share a common identity or in simpler terms that "interact with one another, that are psychologically aware of each other, and that perceive themselves to be a group." (ibid.).

Groups as well as organisations have content and a process (Osland et al. 2002, p.195), and multiple influencers such as group size, member characteristics, individual objectives and the stage of development of their team all have influence on their identities. The reason for the group's existence is the "what", whereas the way the group functions is the process. Group size is of influence because in a small team, an individual can participate more. In contrast, a large team is said to have a greater diversity (Hardy 1999, p.155).

7.3.2 Types of groups in organisations

When discussing formal organisations, the basis for group formation is usually their function within the organisation, the "what" (Schein 1970, p.81). These functional groups are created to fulfil a specific goal and carry out specific tasks, either permanent or temporary. However, human beings have needs beyond those of "purely fulfilling their jobs". Therefore, informal relationships develop that often turn into informal groups (ibid., p.82). These groups can be horizontal, vertical or mixed and they fulfil needs for affiliation and a sense of identity; they might develop, enhance or confirm self-esteem, they can increase stability, security and give a sense of power, and they might help to get the job done (ibid. pp.84-5). Usually groups within an organisation serve a formal and an informal function; they serve the need of the organisation and the individual.

7.3.3 Professional cultures

Professionals in a discipline usually organise knowledge and intellectual tasks in ways that work well for their objectives and that have worked well in the past. This knowledge derives partially from experience, but in higher qualified professions, to a large extent, work and knowledge is organised according to an educational structure. One can speak of "knowledge communities" or "academic cultures" (Becher, 1989, p.1). If there is such a thing as role and group-identity through a discipline or profession, then there should be a group-identity as a mechanical engineer, or a role-identity as a mechanical engineer, vs. his or her electrical engineering colleague. Moreover, if there is, influence on the interpretation of a situation of technological change needs to be determined.

Scanning the literature for professional cultures and preferred work styles for the engineering profession is not very rewarding. Working styles and development specifics of software developers have been analysed in various ways (e.g. Campos and Dunes 2007; Floyd, Reisin and Schmidt 1989; Mathiassen 1998; Myers, Hudson and Pausch 2000; Sieber 2006; Pasch 1991) and they have even been linked to software developers' "perspectives" and "cognitive universes" (Nygaard 1986). However, no satisfying work on the variety of professional engineering sub-cultures and their differences could be found.

7.3.3.1 Disciplines, their origin, definition and characteristics

Qualifications for professions such as engineering are usually manifested in specialised knowledge, obtained through a higher education system and its practical application, usually in an organisational context. Thus, one way of looking at different professions and their common texture is through the organisation and structure of the knowledge they work with, which is usually referred to as academic disciplines. These academic groupings, their attitudes, activities and cognitive styles are closely bound to the characteristics and structures of the knowledge domains these groups are professionally concerned with (Becher, 1989, p.20). As Abbott (2004, p.5) explains, disciplines are "not organised into a clear system, but take their orientation from various historical accidents". Economics are organised by the theoretical concept of choice under constraint; political science by the social aspect of power, history by an aspect of temporality, and so on. Characteristics of a discipline can be the disciplines nature and content, its internal and external boundaries, its degrees of unity across sub-disciplines, the extent to which its profile varied from one country to another, and so on.

Since often historical and geographic differences apply, it is relevant to note that the data in this paragraph relies on Anglo-American, British and German sources. The origin of geographic phenomenon is illustrated in a joke that describes a project meeting between three engineers, one from Asia, one from the US and one from Germany. In order to make the meeting more efficient, management decides to send the Asian engineer's boss, to tell the American to stop talking and take the Excel spreadsheet away from the German engineer. In a German/Swiss conference

setting with product development managers, traditionally educated as mechanical engineers, everyone laughed and nodded, identifying with this categorisation.

An interesting aspect is the notion of "discovery", which seems crucially important in some disciplines, such as in physics and molecular biology, but the term is out of place for example in law. In mechanical engineering, the concept of discovery is replaced by "invention". As Becher (1989, p.5) brings forward, these differences have something to do with social norms, but they also partly derived from the epistemological characteristics of their discipline's knowledge base, which brings up the next topic.

7.3.3.2 Categorising knowledge

A classification of knowledge develops, when one looks at the degree, to which knowledge paradigms exists and how they restrict action in order to find a solution. In that respect, knowledge from "restricted" or "unrestricted science" generates "restricted" or "unrestricted knowledge" (Pantin 1968; cited in Bercher 1989, pp.8-9), or in a different terminology: hard vs. soft knowledge (Biglan 1973a; cited in ibid., p.11). Restricted or hard knowledge has clearly defined boundaries and it addresses narrow, clearly defined problems or issues with an agreed upon set of methods. Unrestricted or soft knowledge has unclear boundaries, and it tackles problems, which are broad in scope and loose in definition. Table 7 compares the two opposite ends in more detail:

Table 7: Restricted and unrestricted knowledge

Restricted Knowledge and Disciplines "hard"	Unrestricted Knowledge and Disciplines "soft"
Defined boundaries, narrow problems and narrow circum-scribed focus on quantitative issues. Convergent disciplines.	Unclear boundaries, problems are broad in scope and loose in definition. Concerned with the quantitative and particular. Divergent disciplines.
Restricted in the fields to which investigator is devoted. No need to transverse to other science.	Investigator must be prepared to follow their problems into other sciences.
Clear cause and effect.	Many causes.
Far reaching deductive consequences but restricted usability for other fields. Grand variety of other fields is systematically excluded.	Re-iterative pattern of inquiry. Evaluation of research results and direction of future work is unclear.
Theoretically specific, clear and coherent.	Relatively unspecific theoretical structure. Messy, "all the way to inherently lumpy".
Tightly knit communities.	Loosely knit communities. A pragmatic structure.
Clear guidelines how to work, do research.	Pluralism and dissent; any systematic advance must await the onset of maturity and the emergence of a paradigm.

Table based on Pantin (1968;) and Kuhn (1962); both cited in Becher 1989, pp.8-11; 153.

The link between these knowledge domains and an overall perceived reality is evident. "Hard" knowledge is close to the positivist claim of an objective, neutral reality and truth whereas soft knowledge is linked to the interpretivist argument that reality is subjective.

The way knowledge is perceived or acquired, leads to another category, which refers to the degree of concern with application. Here, one can speak of pure vs. applied knowledge (Biglan 1973a; Kolb 1982; cited in Becher, 1989, p.11). This category, together with the previous one leads to a refined matrix as shown in Figure 20 of different forms of knowledge in different disciplines. Natural science and mathematics are perceived as hard and pure, while science based professions, such as engineering are in the hard-applied corner. Humanities and sociology are the soft science and social professions are in the soft-applied quadrant.
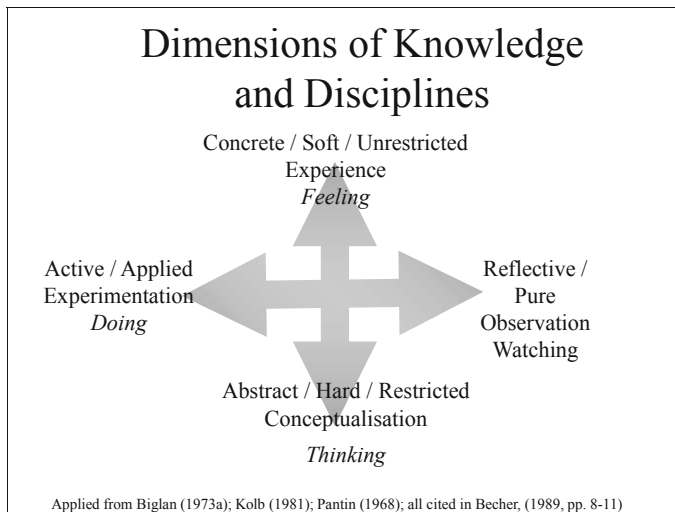

Figure 20: Dimensions of knowledge and disciplines

Unfortunately, no further information is available on engineering sub-disciplines such as electrical engineering or automation. This information would be helpful to detail the various engineering disciplines further within the hard-applied quadrant. However, a few hints have been offered by managers of various engineering disciplines (personal conversations, Angerbauer 2008, Häberle 2008, Kolb 2007, Schiek 2008) and the Head of a university engineering department (personal conversation, Würslin 2008). They observed electrical and electronics engineering

knowledge to be less hard than mechanical engineering knowledge; electricity, as well as electronics, was said to miss the hard, "tangible" facts that can be directly observed by vision and other senses. Electrical and electronic engineering "facts" are less observable. They usually require instruments to measure effects. Even less tangible, less hardware centric and thus even more unrestricted and open to interpretation are knowledge and methods used in programming. This discipline can be segmented between highly structured and planned "hard" programming styles all the way to interactive "soft" programming without much of a concept; programmers can be grouped in "experimenter", "theorist" and "craftsman", others differentiate "hacker" and "professional programmers" (Sieber 2006, pp.57;60; translated by the author).

7.3.3.3 Characteristics of mechanical engineering knowledge
Using the discussed categories, mechanical engineering is said to be "a very wide-ranging subject", primarily concerned with "the application of mechanical principles to technical devices", under consideration of economic, environmental and social factors. It is predominantly a professional discipline, where problems usually have no unique solution. Knowledge follows the development of understanding and technique, and in this sense, it is cumulative. The relevance and implications of particular results are not necessarily clear, but they are implicit (Becher 1989, p.7). These categorisations of engineering knowledge offer a structure between engineering knowledge that might, but does not have to emerge as relevant.

7.3.4 Academic disciplines
This section discusses the structural framework taken for granted in the higher educational system, and analyses the way disciplines and the respective individuals working in these disciplines usually differ. This point is emphasised by Kolb's (1981; cited in ibid., p.12) observation that professional learning styles are strongly associated with undergraduate educational experiences. Underlying this is the understanding that academic disciplines define their own identity and defend their own patches of intellectual ground (ibid, p.24), a phenomena described as "cultural capital" (Bourdieu 1986) in sociology.

Becher identifies two kinds of academic disciplines with a direct and reciprocal effect on their respective knowledge domain and on the methods used. There are convergent disciplines with a rather narrow central core of theory, strong collective kinship, strong collective ideology and thus a strong collective worldview. Examples are physics, history, mathematics, or economics. On the opposite end are divergent disciplines that are diffused across a wide field and that lack a central core of theory. Engineering is one of these divergent disciplines, because the theoretical foundation comes from a range of areas, depending on the sub-discipline considered. Furthermore, engineering is an applied science, thus it is situational and open to external influence. Observing community life at German engineering faculties confirms this evidence. Engineering students are divided into

subfields from the first day at university. They then divert further into areas of specialisation in the final master years. The conventional terminology used among various engineering disciplines when referring to each other is one way to demonstrate and manifest a common sense of belonging. For mechanical engineers, electrical engineers are 'screwers' ("Schrauber"); according to other engineering disciplines, a mechanical engineer is often said to only think in "blocks" ("Klötzchen") (personal conversation, Würslin 2008). This indicates a lack of common identity among engineers of various sub-disciplines, however it also hints on an existing identity within the various sub-disciplines. Membership within a discipline comes with a reputation, a group status. Thus, the pecking order between engineering disciplines could be important in the context of synergising different engineering disciplines. As with many issues of social discrimination, this also has to do with wider national values and, therefore, it differs between countries. In unison, the western academic world seems to value hard, pure disciplines most; however, the world of practice segments differently (Becher 1989, p.161). Germany industrialisation started late and depended on foreign technology until about 1870; Forty years later, German engineering together with US based engineering overtook the originally dominating British industry (Müller-Jensch 2002, p.221) and became a factor for national pride that remains until today. In contrast, the social sciences are comparatively low in rank, seen as "useless disciplines", not suitable to make a living. This can be contrasted with e.g. Great Britain, where Becher (1989, p.161) talks of an "anti-utilitarian snobbery".

7.3.4.1 The engineering culture
In his extensive study on the cultures of disciplines, Becher describes the engineering culture, as clear and unsurprising:

> *Their practicality and pragmatic values are frequently emphasised; they are respected as being "in touch with reality". But at the same time they come across to their more hostile observers as dull, conservative, conformist and mercenary; as unintellectual, unacademic and 'not very clever; as politically naïve and uncultured – "technocrats with no refinement". Those who take a more favourable view see them as hearty, likable and enthusiastic; as creative, lateral thinkers; and as having a broad outlook.*
>
> *Becher 1989, pp.28-9*

Some of the labels engineers give themselves are "stable introverts", "hard working", "conformist", "coping badly with people", and a "lacking communication skills". While they see themselves traditionally bad at self-expression, they are able to "think clearly", they "know what they are doing, how and what for". "A good engineer knows how to cut out the dross and get to the heart of things." (ibid.). Cultural differences also apply: the French engineer has an absolute approach, starting with mathematical explorations, US engineers work

comparatively, starting straight into a solution and looking into the relative merits, where German mechanical engineers are seen as "heavy handed" (ibid. pp.21-2).

An interesting historic source for some categories of collective interpretation of engineers and their thinking patterns can be extracted from the analysis of mainly German engineering notebooks of the 19th century. They revealed a surprising similarity of knowledge management between very different individuals. Dienel (n.d., p.1) concludes that the underlying mental model to structure information was very similar. Engineers used the notebook to memorise, select, and construe data. In general, two basic forms of data were found: there were the "much-writers" ("Vielschreiber") (ibid, p.3), who sequentially described what they saw. Detailed drawings accompanied this filing of information, and often some form of directory for structure. In contrast, there were the "little-writers" ("Wenigschreiber") (ibid., p.3) that used a non-sequential order, and usually took a long time until they committed themselves to a format they stayed with. These "little-writers" had their emergency ration of knowledge in those notebooks, a kind of formulary. The books contained ideas, projects, to-do-lists, communication notes, measurement and its interpretation, as well as dates, and there was usually the attempt for some sort of content structure. The books were used to support and stimulate memory. While slip boxes were an alternative available at the time, they were hardly used by engineers. Dienel (nd.) wonders if this is because they were never finished, and the writer was never done. Writing in a notebook demands a final decision. (Dienel nd., p.6; translated by the author).

7.3.4.2 The developing discipline of Mechatronics
The newly emerging discipline of mechatronics is an interesting phenomenon, where engineering disciplines synergise from fragmentation to wholeness, driven by practice of application. While the theoretical idea of synergies between mechanical, electrical, electronic and program engineering is 40 years old, the barriers between the sub-disciplines are huge and the synergetic thinking seems to be primarily favoured at the engineering management level.

Meeting the synergistic demands of mechatronics requires the integration of different technical disciplines and different thought concepts. Unfortunately, one-dimensional abstraction abilities along with knowledge from primarily one sub discipline are the toolkit of today's typical engineer.

7.3.5 Discussion of the categories of disciplines
Categorising disciplines is helpful in offering structures and typologies, that could emerge as relevant 'divides' when investigating social influences on technology adoption. Such divides can reduce complexity to a manageable level (Kolb 1981; cited in ibid.). Never the less, it is important not to oversimplify differences. Professional and academic disciplines do not neatly fit the categorisations offered, and therefore any attempt to categorise must remain a guideline rather than a dogma. Especially within the spectrum of engineering disciplines, some theoretical

aspects are purer and closer to the natural sciences, while others are more applied, some engineering knowledge is harder and clearly conceptualized, and others are softer and more concrete. There are multiple hints that suggest a graduation from hard towards more soft knowledge (however still within the hard segment) and this graduation seems to start with the mechanical physics of power, the oldest and most tangible engineering knowledge and it seems to end with the non-physical and hardly measurable discipline of software engineering.

7.3.6 Discussion and consideration of groups within organisations

The review of existing theories and concepts around professional and academic disciplines reveals many aspects and ways for the categorisation of knowledge and their respective disciplines. Since there is ample evidence that groups have a major impact on their members, it is likely that professional and academic disciplines have influence on their members' behaviour in a situation of technological change. The picture found about the 'typical engineer' and engineering disciplines are pragmatic and rational all the way to technocratic; the qualities of a reflective thinker in soft categories seems to be less present; engineers and technicians are described as rather conservative and conformist.

Engineers are trained to select from a variety of options and alternatives in theory and method-based criteria, thus they do not perceive their perspective as restricted. However, their perspective seems restricted to the "hard" disciplines and to tangible forms of knowledge that are perceived as true. Thus, one can speculate that engineers predominantly share a mechanistic, positivist worldview, with a neutral reality that clearly distinguishes between right and wrong. Being grounded in applied knowledge indicates that technology for engineers is primarily a tool to serve humankind according to whatever intentions they have. This perspective of looking at the world is influential when making sense of a situation, and thus it can be significant when aiming for a coherent identity.

When mechatronics thinking is required, educational background and status thinking should be taken into consideration. The presented data on the collective identity of engineers showed an interesting mismatch. On the one hand Becher (1989, p.155) concludes that engineering is a divergent discipline which lacks a core of theory and thus lacks a collective ideology and worldview. However, he offers detailed descriptions of engineers and assigns very clear and unison characteristics to "an engineer", which is typically somewhere in the area of introvert, precise, orderly, boring. Dienel shares the observation of an engineer's preference for unquestionable facts and 'truth', and Kolb's positioning of the engineering discipline in the hard-applied field of knowledge and learning characteristics also substantiates this position. The lack of one 'engineering-identity', yet the seemingly unified behaviour might derive from the broad range of engineering disciplines. Electrical engineering has a completely different knowledge base than mechanical engineering, and software engineering is based on yet another, completely different field of knowledge.

It is beyond the scope of this study to specify the differences of the disciplines in complete detail, but further investigations might be revealing and could explain much of what seems inconsistent and confusing in the field of mechatronics.

7.4 Career Anchors: Individual interests within Organisations

During successive occupational and life experiences in a work setting, Schein (1996, 2006a,b,c) suggests that individuals develop an increasingly stable and accurate career related self-concept, he calls "career anchors" (ibid.). They reflect an individual's self-concept at work, consisting of self-perceived talents and abilities, basic values and an evolved sense of motives and needs (Schein 1996, approx. p.1); it is the individual criteria of success used by the individual to judge and measure him- or herself (Marshall and Bonner 2003, p.282).

Schein (2006b, p.1) distinguishes between an individual's "internal" career, which are the individual's subjective opinions, vs. an "external" career, that can be described as the actual steps of career moves. This chapter is concerned with the internal career. Internal careers develop over approx. 10 years of actual work experience and they function as a stabilizing force, expressed in the metaphor of 'anchors'. Most individuals might not be aware of their career anchor, unless they have to make choices regarding their self-development (Schein 1996, approx. p.2).

The concept is used to aid individuals in career choices, and to help human resource departments to match the right individuals to the right job and vs. In the context of this research, such stabilizing concepts offer an individualistic typology in the working context. This is especially promising, since 'a sense of stability' has already emerged theoretically as a key factor to further understand technology adoption. Schein's concept showed that most peoples' self-concepts resembled around one of eight categories of basic values, motives and needs:

- Technical/Functional competence
- General Managerial competence
- Autonomy/Independence
- Security/Stability
- Entrepreneurial Creativity
- Service/Dedication to a cause
- Pure Challenge
- Lifestyle

7.4.1 Technical/Functional competence

This individual anchored in technical/functional competence has a high motivation and a talent to achieve a high level of technical or functional competence. It likes being challenged in this field and a sense of stability is derived from the perception that the competence is valued and oneself is 'marketable'. These individuals are anchored in "I know how to do it". A good indicator for this career anchor to fit is that they will not like to give up this competence for the sake of a general management task, which does not mean they will not try this career move. Their main concern is to apply and maintain a level of knowledge in their specialized area

in order to do their job properly and better than almost anyone else. Worries grow from the experience that knowledge and skills become rapidly obsolete, and thus they require constant updating.

7.4.2 General Managerial competence

Unlike their technical/functional counterparts, these individuals are motivated to exist in a political environment. They hold the emotional make-up to make highly consequential decisions with only partial information, and they have good analytical, financial and interpersonal skills. They like being in charge, solving problems and dealing with other people. They are motivated to climb to a managerial level, and to be responsible for overall results. Their main concern revolves around obtaining a responsible job and achieving organizational success. These skills are increasingly in demand, as more complex work requires increasing coordination. However, managerial ladders become increasingly difficult to climb and status might be dependent on skills rather than on hierarchy, which results in the fact that that managerial competence might become a process skill.

7.4.3 Autonomy/Independence

These individuals have a primary need to work by their own rules, and they are highly self-reliant and need the feeling of being free and on their own in their career. Consequently, they would never give up the opportunity to define their own work. Such individuals are well aligned with future organizational tendencies.

7.4.4 Security/Stability

Some individuals have the overwriting need to manage their career so they can feel secure and safe. They put a high priority on employment security, financial security or geographic security. They are anchored in "having made it" and would never give up their employment security and tenure in a job. Thus, they are driven to achieve a sense of a stable career so that they can relax. While organizations change from "employment security" to "employability security", their dependence on the organisation shifts towards themselves. This is not a good feeling for those anchored in security and safety.

7.4.5 Entrepreneurial Creativity

These individuals seek an autonomous career or entrepreneurship based on their abilities and willingness to take a risk and to overcome obstacles. Financial success and organisational growth serves usually as proof of this success. Their dynamic, mobile and flexible approach along with their willingness to take a risk is increasingly in demand and well regarded in western capitalistic economies.

7.4.6 Service/Dedication to a cause

Service-oriented individuals aim to do something meaningful, they want to help other people or serve a larger purpose. To do something of value and meaningful stabilizes them. According to Schein (2006b, p.21) an increasing number of

individuals feel the need to not only maintain an adequate income, but to contribute to a cause.

7.4.7 Pure Challenge

Individuals driven by challenge constantly seek difficult problems that they can tackle. They want to overcome impossible odds, solve insolvable problems and win out over their competitors. Being challenged by novelty, variety and difficulty seems to be an end in itself and, therefore, these individuals cannot give up the idea of seeking challenges and competing. Since it is unlikely that there is a shortage of challenges in the future, these individuals' active learning approach is valuable.

7.4.8 Lifestyle

Lifestyle anchored individuals see their work and career as part of a larger "life system", where family and private concerns get integrated into the career plans in order to achieve a particular life style. Living a balanced life is the anchor for these individuals. There seems to be an increasing trend towards this life style, which reflects the changing occupational structure where organisations owe the career occupants less and less as individuals become increasingly self-reliant.

7.4.9 A critical assessment

Numerous follow-up studies have sought to refute the theory, but the basic career anchor typology has held firm, despite significant changes in career models over the past few decades (Marshall and Bonner 2003, pp.281-2).

One major aspect where his concept is challenged is the assumption that career values, motivations, and attitudes develop over ten years or more, and once they have emerged, Schein assumes them to be consistent throughout the rest of the career (Schein 2006, p.5). This understanding is reinforced by some further studies (Yarnall 1998, p.59), however, other studies offer some emergent relationships between career anchors and age (Bonner 1997; cited in ibid, p.283; Feldman and Bolino 1996, p.92; Igbaria et al. 1999, p.45) as well as downsizing (Marshall and Bonner 2003, p.285). These studies claim that both age and downsizing are experiences that alter an already existing career anchor. This research study's theoretical position is consistent with a more dynamic assessment of career anchors, because meaning systems are defined as dynamic systems. Schein also assumes only one true career identity for each individual. Consecutive studies (Feldman and Bolino 1996, p.94) argue, that the different dimensions of career anchors (some are need based, others talent or value based) allow more than one anchor at one time, especially so, because the anchors address more than solemnly career issues (p. 99). Further, the concept has no cultural or professional influences on the overall distribution of career anchors (Schein 1996, approx. p.2). There are studies that support this view (Danziger et al. 2008, p.17; Yarnall 1998, p.59) and others that falsify it (Igbaria et al. 1999, p.43; Marshall and Bonner 2003, p.285). Along with the previous point, it is suggested from various researchers that the career anchors should be altered. While some suggest a four anchor solution

(Nordvik 1996; cited in Danzinger 2008, p.11), others suggest nine factors (Danzinger 2008, p.7) and yet others offer eleven factors (Igbaria 1999, p.29).

Overall, one can point out that Schein's sample size was relatively small and it was homogeneous: highly educated individuals in their late 20's, early 30s (Yarnall 1998, p.58). It might not be surprising that different studies show some alternate results while others are consistent. An analysis of the various samples might offer some answers. However, this is not the focus of this study.

7.4.10 Consideration
Career anchors reflect the beliefs, goals and values an individual has in regards to its working life (Marshall and Bonner 2003, p.282) and, therefore they could be called an individuals' "career-identity". To what extent career anchors help to make sense of individuals' behaviour in the situation of technological change remains to be seen.

7.5 Discussion and consideration of the organisational perspective

Organisational-, professional-, academic- and career-identity seem relevant aspects that are likely to exert influence on an individual's behaviour in the situation of technology adoption. They offer categories and sorting criteria and thus they are social structures that can underlie behaviour. Which ones of the social organisational structures introduced will emerge as related to technology acceptance behaviour will be revealed in the empirical part of this research study.

8. A Merged Perspective

8.1 Introduction

The following section summarises some of the most influential theoretical findings and experiences as they have emerged from the theoretical frame analysis. In the end, it reflects the augmented consciousness now available to the research problem. Figure 21 illustrates roughly the spectrum of the frame analysis.
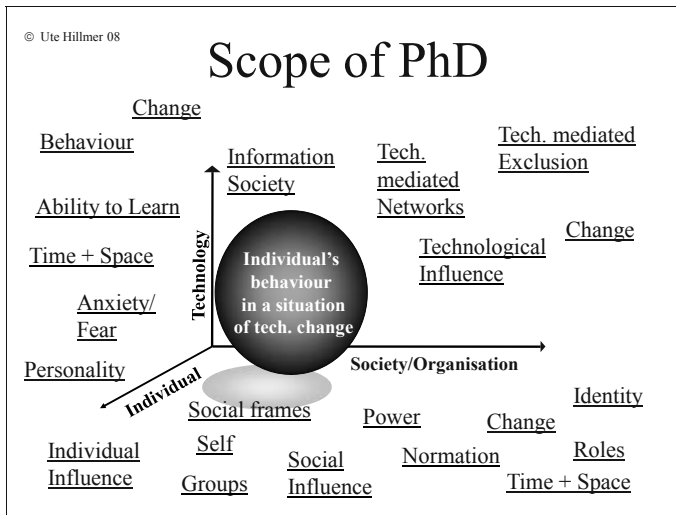

Figure 21: Scope of frame analysis

8.2 New consciousness of a merged perspective

8.2.1 Individual perspective

As a result of the literature investigation from an individual-centric position, the individual's self is understood as a self-system, that functions as part of a motivated meaning system, the reference point for any behaviour and action. This self-system builds, maintains, promotes and protects its self-concept, self-esteem, self-relevant goals and values over a lifetime. The self-system can be understood as a uniquely networked system of units, some are input- or output-units, others are intermediate, not readily observable units. From this point of view, meaning is the resulting product of a network-connection of units, selected dependent on stimuli and on the network's unique topology. None of the generated meanings is stored for recall, each network connection is generated anew. Consequently, changed units, slightly

different stimuli and insufficient memory can change a situation's meaning and the consequent behaviour in a recurrent situation.

The individual perspective also revealed symbolic interactionism based identity theories as a means to get closer to an individual's meaning system, and the meaning attributed to a particular situation. For each typical position and membership an individual holds in the social structure, it owns an identity, a readily available set of values, beliefs, goals, norms, needs and a morality, that guide behaviour within this life-position. Most identities are culturally and experientially derived understandings that are shared within a society, called social identities. Furthermore, there is personal-identity, a form of identification, that is inherently personal and unique, and that penetrates social identities, providing overarching self-integrity with a core 'me'. In its combination, this leads to the sometimes observed paradox of invariant personality with a parallel variability of behaviour.

8.2.2 Social Perspective

The social perspective attempts to uncover the hidden bias and taken for granted understandings that dominate our behaviour, especially in relation to technological change: our social reality. Social realities are usually internalised and acted out in social identities. Further investigations into the technological and social changes of the 21st century reveal an increasingly technology-networked society that is linked by collaborative ties rather than cohesive or traditional ones as in former societies. Individuals derive their sense of self no longer from society by birth. They have to make their identity choices within an accessible spectrum. Unfortunately, these network identities come along with a lot of uncertainties and risks in the binary logic of a preceding network society: 'non-contributing' members are easily excluded. Furthermore, the dynamic inherent in network societies bring along constant changes in beliefs, values and morality. The diversity of identity choices, constant change of social beliefs and values, new forms of unpredictable risk and at the same time the individualised responsibility to make the 'right choices' make the creation of meaning difficult and stressful for many individuals. Social change and technological change might often be cognitively and emotionally inseparable for many individuals.

8.2.3 Organisational perspective

The organisational perspective uncovers further social structures that can influence behaviour in the organisational context. It offers insight into additional sources for identity concepts that can affect the individual. There are organisational cultures, professional and academic disciplines, as well as career anchors that all can offer social structures and conceptions to create meaning and routine concepts for behaviour.

8.3 Final considerations concerning the research problem

The characteristics of the 21st century society require new or modified qualities within an individual. Social identity is no longer handed to the individual by society, there is no longer one social reality that explains the world; instead, a dynamic and fluid social reality affects the late modern self. This self has to cope with contradictions, uncertainties, and with heterogeneity in social realities. The self becomes multi-layered and complex (Smith-Lovin 2003), because it is no longer embedded in one homogeneous life-nexus. The individual acts in a world of different components, each one with a different social code and different expectations, the self becomes a multi-identity self. This is said to lead to a disintegration of the self (Helsper 1997, pp.177-8; Keupp 2006), because it is no longer 'fully involved' in any one of the components of life. There is even the argument that these partial aspects of life remain relative and alien and this alienation remains an aspect of the self (ibid.). However, opposite voices claim that only a complex, multi-identity self is a strong self (Smith-Lovin 2003; 2007; Thoits 2003) and they do not speak of fragmentation but of multiple-identities. They claim that more complex selves are better buffered from situational stress (Linville 1985, 1987; cited in Stets and Burke 2003, p.14), because multiple identities give live a meaning, guide behaviour (Smith-Lovin 2003, p.174; Thoits 2003, pp. 180-1), it is even said that multiple identities have positive effects on mental health (ibid.). A possible explanation for the discrepancy between a negative fragmentation vs. a positive enrichment of various identities is the differentiation between obligatory social identities vs. voluntary ones. Voluntary identities might be enriching and stabilising, while obligatory roles only have a positive effect, when chronic stains are low (Thoits 2003, p.190). Thus, dependent on the identities investigated, the resulting effects can vary.

Another understanding emerges from the multi-disciplinary perspective. The self as a whole is the reference point for behaviour and action, and when the social self no longer offers guidance, the individual self fills the gap. Thus, autonomy and individuality are high values in late modernity. However, a paradox situation develops between increased individualisation and increased institutional reflexivity, where externally given structures and processes define 'the right behaviour', leaving the 'individualised individual' no choice (Giddens 1991, pp.137-9). A tension between a fully individualised private sphere and a highly standardized public sphere arises; Helsper (1997) calls this a crisis of domestication. Additionally, there is the unsettling feeling of individual choices in the face of unpredictable risk that offer no resources for reflection (p.178). All these contra-dictions in the 21st century easily result in a failure to meet one's own high demands towards the self-concept, leading to a fundamental crisis in self-esteem. As Berger and Luckmann (1966, p.125) put it, the modern self lacks a sense of being rooted in society, in itself and in the universe. Identities traditionally give a sense of self-integrity. They stabilise, because they are routine practices that offer guidelines for

behaviour and a footing what to expect from others, thus they are important reference points how to cope in a particular situation. Identities of the 21st century are increasingly in transition and changing, giving routine less space to cultivate. Depending on the individual's combination of identities, along with the unique personal identity, the individual feels rather coherent or fragmented, has a feeling of integrity or not, which might be a key indicator for technology acceptance behaviour.

For the consequent steps of this research, an increased awareness and sensitivity towards an individual's sense of stability and towards the factors that stabilize and destabilize a particular individual seem of importance. Furthermore, the question of how a particular technology contributes to this perception must be carefully investigated, thereby, increasing sensitivity to these areas which are likely to release valuable understanding for technology acceptance behaviour.

Part IV: Findings

9. Emerging Data and Data Analysis

9.1 Introduction

This chapter presents data that was developed through the various data development methods and that emerged as relevant through the constant comparative method of grounded theory. The data development process, the coding and theoretical sampling that emerged through constant comparison are illustrated, and the visual interpretation of the data that is used throughout this analysis and discussion is explained. Thereafter, the emergent data are presented. Their significance will be discussed in the consecutive chapter of data discussion.

The majority of data was gleaned from semi-structured interviews that investigated the technology adoption behaviour of twenty-two product designers in seven German mechatronics machinery companies. These employees engaged in a variety of different technology acceptance behaviour. Questionnaires, a conversation with management for each department, and some purposeful follow-up e-mail and telephone conversations were used to gather information. This information was used to fill data gaps that emerged through the action research approach. The purpose was to reveal the individual's subjective interpretation of a situation of technological change, and this interpretation's relationship to technology acceptance behaviour so that it could be determine if patterns emerge that help the interpretation process for an external observer. All German quotes by the interviewees used in this dissertation were translated by the author, for the purpose of maintaining the originally used interpretation of the sentence.

9.2 Data development processes

9.2.1 Gaining access

Access to participating companies and their designers was achieved by contacting key mechatronics networking associations in the region: the mechatronics branch of Baden-Württemberg Connect "bwcon" and, the "Kompetenznetzwerk Mechatronik"; as well as through a mechanical CAD software vendor.

Twenty-three CEO's and construction department managers of possible participating organisations were contacted, the research and its purpose explained, and permission for use participants requested. Nine organisations saw possibilities to offer access within a timeframe of seven months, three more within twelve month. Within the final seven participating organisations, thirty questionnaires were answered, of which Twenty-seven were completed. Twenty-two in-depth semi-structured interviews were conducted, each one lasting in average 1.5 hours.

During the interview, notes were taken by the researcher, and for nineteen interviews, permission was granted to additionally tape the conversations. The field data development part of this study was conducted from December 2007 through June 2008.

Management received a letter and a set of PowerPoint slides introducing the study. To respond to management's concern about designer's time spent in the research during a booming economic time, instead of five to six, only three to four respondents per company were interviewed. Researching technology acceptance in conjunction with personality related factors is research in sensitive and intimate personal areas that can be misused as ranking data for employability. In many cases, the human resource department and the work council was involved to assure the strict application of confidentiality agreements. Therefore, high confidentiality precautions were taken and not even company names were released.

The appropriateness of the participating organisations and participants were evaluated by introductory telephone conversations with the department managers. New design technology had to be implemented within the last one to three years in order for the reported data to relevant, and there had to be at least three to four users of the this technology in order to allow for intra-organisational comparison. Furthermore, there had to be a variation in technology acceptance behaviour to allow for inter-organisational comparison. Organisations that did not meet these requirements were not included in the study. Once the appropriateness of the site was confirmed and accessed, the research study was presented to the respective team members.

9.2.2 Data development through the questionnaire
The questionnaire asked about the perceived company and work team culture, own technology adoption behaviour and associated efforts, information and communication networks, and some aspects of the self-concept. Additionally, it collected self-reported perceptions and behaviours as well as self-concepts during a specific process of technology adoption.

After a pilot study was conducted using four technical respondents, some questions were rephrased in order to make sure the appropriate information was collected. After conducting ten interviews, three sets of questions were added. The content of those new questions repeatedly emerged in the semi-structured interviews, and were well suited to a questionnaire format, thus this freeing the interview to spend more time in other areas.

9.2.3 Data development through face-to-face semi-structured interviews

Participant's external reality
The first direction of inquiry covered technological change, as is perceived by the individual. The questions were open ended, and allowed for participants' free interpretation of the term "technology", which had given insight in different

meaning systems. Furthermore, the interview started with an indirect terminology of "most people" and "the work team" allowing for some non-threatening conversation in order to build trust. In addition to the technology perception, the terminology emerged to give first impressions of an individual's perceived sameness or otherness with his organisational environment.

Subsequent questions covered the situation of technology implementation. Probing for possible structural or emotional problems with the implementation process ensures that adoption behaviour is not confused with implementation process problems. At this point, hidden power struggles also emerged.

The last question in the interview asked for an overall statement about "how this world functions" to further gain insight into individuals' overall worldview and reality. Since open self-reflection is rather unusual in a business context, expectations towards this question were low. The deep insight and serious reflection and its correlation to technology acceptance behaviour emerged as a pleasant surprise that will be further analysed and discussed in this and the following chapter.

Individual's self theories
These questions covered participants' beliefs about themselves, their learning attitudes, and how they cope with difficulties; their sources for self-respect and motivation, and their perception on internal conflicts and possible solutions is investigated. Towards the end of the interview, participants reflected on technologies' effects on their sense of stability and embedment in comparison to other factors.

Participant embedment investigation
These questions investigated a participants' embeddedness in the respective organisation and teams. It was up to the respondent to define the boundaries of the network, which is called a realist-approach to network boundary definition (Wassermann and Faust 1994; cited in Marx 2004, p.107); it captures the network of relationships and possible influences as perceived by the individual. Of relevance are the amount of different ties surrounding the respondent and their perceived strength (Abdelal et al. 2001, pp.9-10). The data on these "egocentric networks" (Marx 2004, p.107) emerged during the conversation and showed high covariance to the salient identity of the individual.

Additionally, a list of twenty-two values, derived from Misztal's (1996) characteristics of stable, coherent, and collaborative social settings were used to determine the embeddedness in the organisation and the work team. Participants were asked to assess the importance of a value for themselves, for their work-team and for their company between high, medium and low. Their narrative answer was translated into a 3-point scale by the researcher and the participant together. The degree of overlap or difference in the ranking of values is used as one slice of data to look at embeddedness. The results correlated highly with the other less

structured and more narrative investigations and will be analysed together with other triangulated data. The list of values is available as part of the interview guide in Appendix 2.

The identity of a participant

In this section of the interview, participants spoke about "who they are at work", formal or informal groups they belong to, their awareness of roles and the dominance of these role- or group-identities. Furthermore, the perceived respective normative frames were investigated. Usually participants were either able to identify with the alikeness of other individuals at work, or they identified with a significant difference, that distinguished themselves from the others. Rarely were participants strong on both, role and group identification.

Qualitative methods from psychology

Three "If… then…" questions were part of the interviews, however, both researcher and most respondents felt uncomfortable with the interrupt in the flow of the interview. It did not fit the otherwise narrative, conversational style. The data that emerged seemed completely out of context in the sense that it was unrelated to the immediate working context and rather hypothetical. An example is "if it were military arms of offence technology, then I would reject… ". A respondent who actually rejected a new design technology within his working context gave this answer. "If … then…" questions were removed from the interview guide to not destroy what became a comfortable, conversational rhythm.

Most respondents preferred to complete the "Twenty Statements Test" (TST) (Kuhn and McPartland, 1972) sheet after the interview, rather than in the interview, so it was taken and sent back by e-mail or fax after completion. The TST can be analysed in multiple ways. For the purpose of this study, it was analysed in two ways: first, in grouping the answers in "external" and "internal", i.e. it located the participant in society by describing role and group identities, and it locates the participant inside her- or himself by describing an interior quality and trait (Elliott 2002). Second, the answers usually include examples of the following types of responses: physical description, social roles, social groups, personal traits, abstract existential statements. The answers can be grouped by those categories. The specific participant patterns are compared to technology acceptance behaviour, and overall differences and similarities between the respondents are analysed.

9.3 The emergent coding and theoretical sampling

This section offers an overview on the steps taken to develop a grounded theory regarding the relationship between subjective meaning and technology acceptance. To develop an understanding of relevant information and of codes, and later theoretical codes to emerge, all available data were constantly compared. The largest amounts of data were from the semi-structured interviews. The notes taken during the interviews as added to the information gathered on the tapes. The

questionnaire data were added to the interview data. Grounded theory processes as described by Glaser and Strauss (1968, 2008) and Glaser (1978) were rigorously followed. The data of the first 15 interviews and questionnaires were compared to other interviews, at that point the emergent code saturated and additional, new interview data was compared to code. When looking over the data, using the constant comparative method, memoing ideas and finding alternate codes for data and subcategories for codes, a concept emerged (ibid., pp.56-91).

As a key concept, a correlation between the individual's predominant identification with groups or roles within the working context, and his acceptance behaviour emerged. While central group vs. role-identity offers a rational for conforming vs. individualistic technology acceptance behaviour, the content of the most central identities emerged as helpful clues to understand participants' particular behaviour in more detail. This content emerged as "in vivo codes" (ibid. p.70), and allowed for the construction of more detailed identity categories that were further reduced to an identity which is most likely industry sector, profession and country specific. A detailed analysis follows. Furthermore, the sociological constructs of "career anchors" (Schein 1996, 2006; Marshall and Bonner 2003), "master learners" (Dweck 2000) and "professional cultures" (Becher 1989) turned out to be useful to guide further coding of data and to add scope and meaning.

In total, thirteen substantive codes were selected, resulting in five theoretical codes, as illustrated in Figure 22, which constitute the basis for the emergent theory. Dominant role vs. group-identity offers the most important initial typology for behaviour. Within these two categories of behaviour, further codes emerged; all related to an individual's subjective meaning system. Dependent on individual's goals, values, beliefs and needs, the content of the analysed participants' central identities at work emerged as being dominated by sometimes one, often two, rarely three of six emerging core variables. Not identical but related to Schein's (1996) career anchors, they have been called 'stability/security', 'technical competence', 'technical challenge', 'managerial competence', 'managerial challenge' and 'work-life balance' in order to reflect the individual's self-concept and driving motivation in the working context.

The theoretical codes "curiosity vs. stability", "influence on the situation" and "degree of competence" also emerged as a function of technology acceptance. Finally, a micro perspective on the changes that go with a new technology, what it does and does not do, how it changes existing processes, working procedures, hierarchies, routines, values of existing knowledge and expertise, data presentations, etc., emerged as another theoretical code.
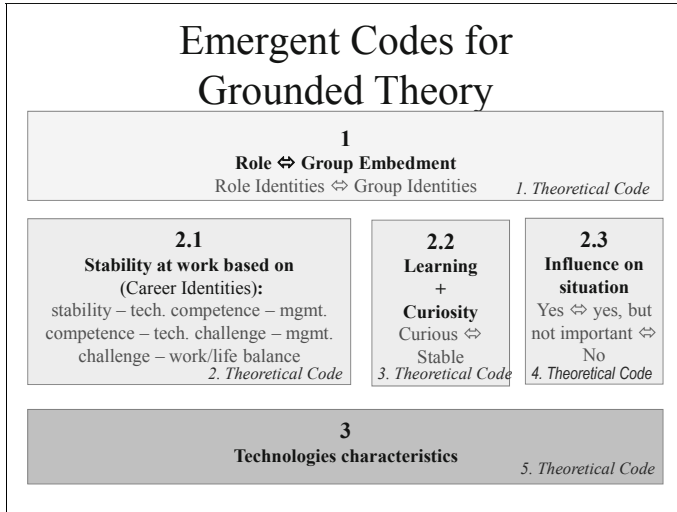
Figure 22: Emergent codes for Grounded Theory

9.4 Visual interpretation aid for various technology acceptance behaviour

The range of different technology behaviour is visually differentiated by mapping it into Rogers' (1995, p.262) bell-shape normal curve of technology adoption, that illustrates the amount of new adopters over time. The participants' point of final adoption, defined in this research as the point in time when they decided to make full use of a technology, can be compared to other adoption over a timeline. Rogers' curve and respective adoption characteristics were introduced in Figure 4.

Each participant who was interviewed in this research was assigned a location in the curve that reflects his self-reported relative point in time when he was ready to make full use of a technology in relation to his peers. This curve and the twenty-two individually different points in time of technology adoption were used to map any other emerging data. This visually aided understanding for emerging patterns. The consequent analysis reported on these most significant emergent patterns, the discussion chapter will thereafter discuss the findings and their consequences in detail.

9.4.1 Different sections in the technology adoption curve

During the frame analysis, the spectrum of technology acceptance behaviour was grouped into the five categories (1) enthusiastically adopted, (2) went along with the change without further objections, (3) initially critical but changed later towards acceptance, (4) initially went along with the change but rejected later and (5) rejected from the beginning. The emergent field data suggest a slightly different

categorisation of behaviour in order to characterise individuals in a way that is observable.
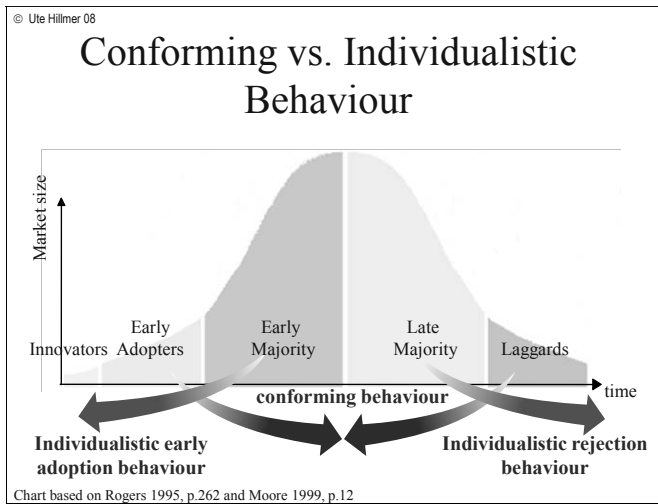

Figure 23: Technology acceptance behaviour over time. Conforming vs. individualistic behaviour

Conforming vs. individualistic behaviour emerged as a significant differentiation in technology acceptance behaviour; furthermore, individualistic behaviour of technology endorsement must be differentiated from individualistic behaviour of technology rejection. These different behaviours are visible in the bell curve, because their actors are located in different sections. A state which has been identified by Rogers (1995, p.262), and was followed by Moore (1999, p12) for the technology sector. Their analysis uses different labels for participants' behavioural profiles, because different, behavioural characteristics were of interest. The characteristics that emerged in this research have significant benefits over Rogers' categories when an assessment prior to observable behaviour is required. Details will be further discussed in the data discussion chapter. Arrows in Figure 23 illustrate the most characteristic technology acceptance behaviours and their respective place in the adoption curve. The directions of the arrows illustrate the direction in which the respective behaviour increases. The blue arrows show increasing conforming behaviour towards the mean of the curve, which is essentially another way to say that at the mean of the curve, the most people adopt a technology.
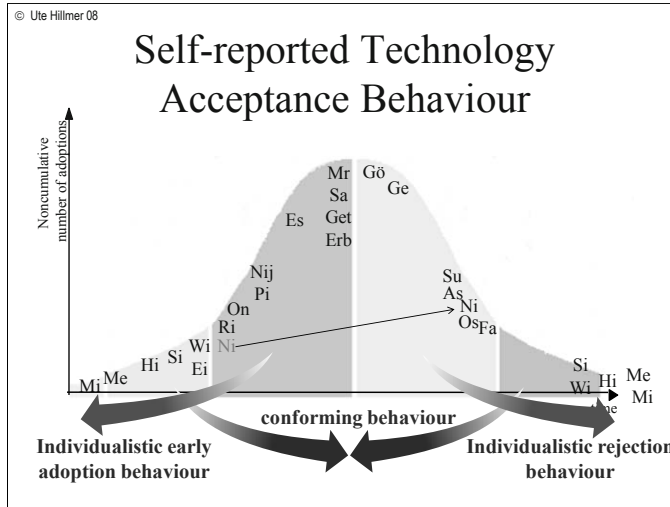
Figure 24: Self-reported technology acceptance behaviour

Their behaviour will be referred to as 'conforming behaviour'. In contrast, the left red arrow illustrates individualistic, early adoption. The more to the left the individual adopts, the more individualistic is its behaviour. The individual behaviour to the right is similar individualistic, but the action's intent is technology rejection. The more right an individual is located, the more absolute is the rejection. This bell curve and its behavioural segments is used throughout the analysis and discussion of the findings in order to give a fast, visual aid for participants' technology behaviour in relation to various aspects that emerged as significant. In a first step, all participants' self-reported technology adoption behaviour were mapped into the bell-shape curve as shown in Figure 24. In one case, the questionnaire based response reported early conforming behaviour, which was significant inconsistency with interview data and management observed behaviour. The questionnaire-based response was dismissed in agreement with the individual. The small black arrow in Figure 24 shows the move. In all other cases, individual's self-reported technology acceptance behaviour matched other, triangulated data that emerged from various sources.

9.5 Early technology adoption and technology rejection

A direct link between very early technology adoption and technology rejection behaviour emerged: from six participants (Mi, Me, Hi, Si, Wi, Ei) who have been very early in technology adoption, five reported other situations, were they rejected technology or vs. One participant (Ei) did not reject technology, but mentioned the possibility.

9.6 Central role-Identities vs. group-identities

The second, highly apparent and important finding is a typology that emerged when comparing technology adoption behaviour with predominant role- vs. predominant group-identities of the participants. Differentiating between central role- and group-identities supports a fast classification between conforming vs. individualistic behaviour. This section outlines the findings.

9.6.1 Central role-identities

Many participants described one or more roles they identify with at work: they are an employee in relation to management, a designer in relation to the shop-floor technicians, etc. However, the degree how important and central these role-identities were, varied significantly among participants. There is an obvious accumulation of parallel role-identities for participants early in technology adoption, towards the end (they are the same individuals), and at the average point of overall adoption.

The centrality of the role-identities and its content emerged as significant to understand technology acceptance behaviour. Very early in the adoption curve or very late are participants with a role-identity that is positively related to self-efficacy (Mi, Me, Hi, Si, Wi, Ei). They perceive themselves as 'doing something better than the rest'. 'Better' usually is voiced in a sense of 'more dynamic', 'more sophisticated or clever', 'more innovative'. These individuals felt capable and entitled to use their personal judgement of a new technology, which usually resulted in individualistic behaviour. Furthermore, these participants wanted to be clearly recognised as different, and in some respect better than all others are and they want it acknowledged. This is in direct contrast to participants with a central role-identity that apply 'mainstream' conforming behaviour (Ri, On, Sa, Erb, As, Ni, Os, Fa). They were much more relaxed about the recognition of any role-identity they hold. "I am the specialist for XY; people usually come to me if they need to get this done fast" (Mr), is typical for a less recognition driven role-identity, compared to "When I tell them their design won't work and I give them an alternative suggestion, they should not even ask – they should know that I know better." (Me). Central roles, participants identified with during the process of technology adoption are illustrated in Figure 25.

Furthermore, the content of the role-identities gave additional indications for acceptance behaviour. Some role-identities had a change supporting content, such as being "more modern" (Ri) or being a motivator or entrepreneur (Hi, Si, Ei, Sa, Erb). In contrast, there some contents were hesitant to change, examples are being a manager who is responsible for customer satisfaction and product continuity (Sa, Erb), or being an older designer (As, Ni, Os, Fa).

It became apparent that participants, who were engaged in individualistic behaviour for or against technology, did not report on any group identity. Even when probed directly, these participants had no answer: "Well, I am usually the one who keeps

up the good spirit and who motivates the others to take a chance" (Hi), was an answer given to the question to what group or team he felt most tightly connected.
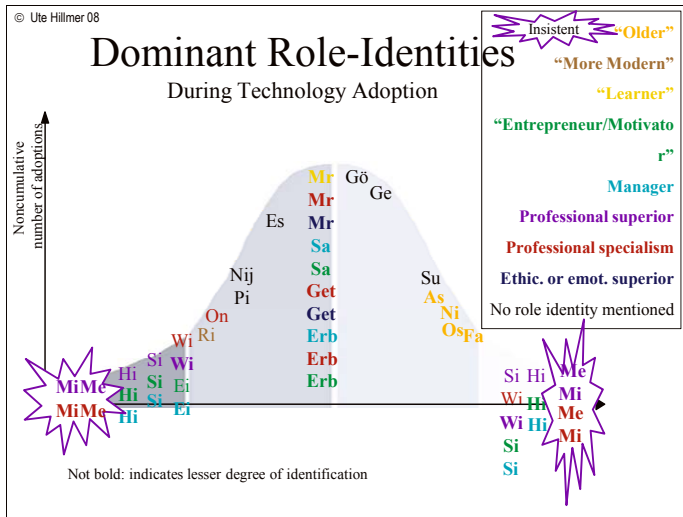

Figure 25: Dominant role-identities during technology adoption

9.6.2 Central formal and informal group-identities

Observable in Figure 26, group-identities guide behaviour, where conforming behaviour dominates. Participants with a central group-identity were eager to be and to remain a part of a larger whole. Some of them had a hard time determining the slightest differences between themselves and their colleagues; they felt uncomfortable with the idea that there might be a chance that they are different. The terminology also reflected tight ties: in four cases, "Gemeinschaft" (German for a very tight "community") was the term of choice to describe the larger work team. They emerged as deeply embedded in some form of the social work structure.

Participants did vary in their group identities, but they all gained some worth-based self-esteem from their membership, as suggested by Grecas and Schwalbe (1983; cited in Stets and Burke 2003, p.131). Group-identities were often described as an important source of stability. One emerging fraction were 'formal groups' within the organisation, such as the work-team, the department, or the company as a whole. Interestingly, the group referred to as 'work-team' was defined differently even among colleagues. For some it was the project team, for others the larger mechanical or electrical construction, yet others saw it to be the overall development team. The professional disciplines also served as groups, participants identify with. In most cases, a professional identity was present, but subordinated to other, more central group identities.

Besides such formal group identities, there were relevant informal group-identities at work, as shown in Figure 27. Additionally, some private identities were proudly mentioned as an integral part of the participants' identity at work: being a conductor and playing seven instruments (Mr) or performing in a semi-professional jazz band (Ri). Others include the non-profit engagement in a disabled sport organisation (Ni). These private identities emerged as a central part of these individuals overall self-identity and self-concept, significant for their overall self-integrity.
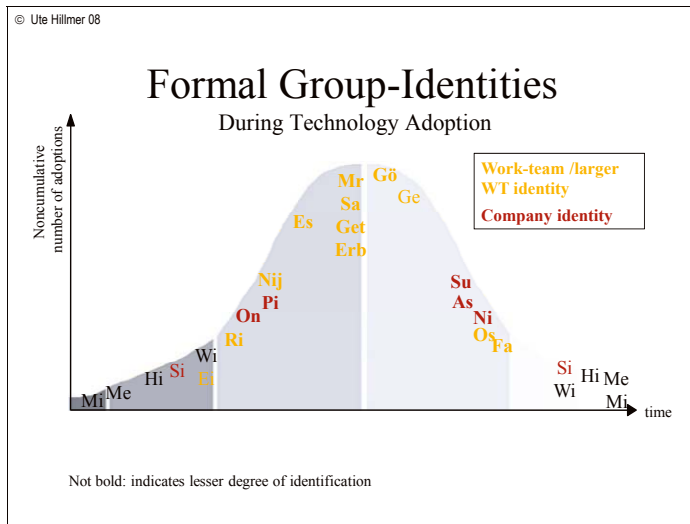
Figure 26: Formal group-identities

One can argue, if job related twin-constellations of friendship at work should be considered a group-identity. The researcher used the participants' perception within that constellation. From the two twin-teams (Sa+Si; Get+Mi), there was always one participant (Sa, Get) that clearly identified with this team-constellation, referring to it multiple times. These two participants reported average behaviour in technology adoption. In contrast, their befriended co-workers did not or only incidentally mention the twin constellation; they also appeared to be the more extravert and dominant part in the relationship. For these participants, the twin-team was not a salient identity when they talked about the adoption of technology. The arrows in Figure 27 illustrate the teams.
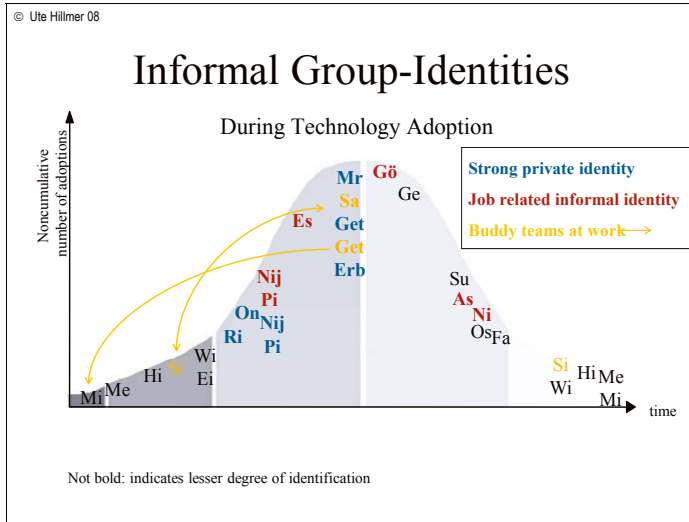
Figure 27: Informal group-identities

9.6.3 Central role-identities along with central group identities

Participants that have both, a strong role identity, but likewise, one or more strong group-identities (Ri, On, Mr, Sa, Get, Erb, As, Ni, Os, Na, Ei, Si) were analysed in three groups, differentiated by their reported behaviour.

The early adopting group that held group- and role-identities in parallel engaged in a combination of individualistic and conforming behaviour and they reflected on the inherent choices. Which side prevailed, conformity or individualism was obvious through the centrality of their parallel identities. Both Si and Ei saw themselves in a role-identity more dominant and important than their group-identity. Si more so than Ei left no room for speculation that he would push or reject a technology and not engage in conformity just to 'fit in' a group constellation. In contrast, Ri and On had clear opinions, felt that they were experts in their judgement but in contrast to Si and Ei, they did value a good working atmosphere and relationship with peers and subordinates as more important than their personal drive. While they wanted to move to the new technology fast, they looked at their peers and decided to contain their enthusiasm until their peers were ready to make a move. It was a cognitive assessment, with the result that group harmony was more important to them than any technical tool that can change again tomorrow. Ri and On both expressed the dilemma and their choice: "it is not worth it" (Ri). All four participants reported on a conflict between non-conforming identities and their values; for each one, a particular social identity dominated over the others. A key to their choices was found in the origin of their self-integrity that will be discussed later in this chapter.

The same logic applied for the participants that were 'very late conformers' (Ni, Os, Fa). They held conflicting identities, however, the desire to fit into the group and not to be excluded succeeded over any individualistic behaviour. In contrast to the early adopters with conflicting identities, this group was much less aware of their conflicting identities. High emotions were observable and expressed, but their origin seemed hidden to most of them.

A different constellation emerged for individuals, who engaged in average behaviour, which positions them at the peak of the bell curve (Mr, Sa, Get, Erb). They had had multiple role-identities that 'balanced their decision' and additionally they had one or more group-identities. They too were fully aware of the trade-offs between their identities and their choices made. A particularly interesting constellation was Mr, who saw himself in the role of a "learner". He was employed as a temporary worker in the past, an experience he would "not wish to repeat at any cost" (Mr). Thus, he was eager and energetic to learn whatever it takes to "fit in". The goal of his role-identity was to gain the necessary features in order to qualify for a particular group-identity he aspired.

Another interesting constellation emerged from Get, a doctor in his profession, who said that he would use the technology given to him, but would utilize it the way he thought most useful. His behaviour can best be described as unrecognised, individualistic rebellious behaviour covered by seemingly conforming boundaries. His rebellious behaviour was small enough so only he would recognise them. He was completely loyal to his smaller work-team (a twin-team), completely disliked the larger team, displayed no emotions and perceived this unemotional world-view to be superior. While others mentioned him to be extremely capable and bright, and heavily engaged in voluntary non-profit work for homeless people, he did not mention any of this.

9.6.4 Triangulation of group- vs. role-identify
Social influences in participants' meaning were approached from various perspectives, using multiple methods. Most of these various perspectives confirmed the typology of participants' adoption behaviour as either group or role driven.

A comparison between personal values, the values of the work-team and company values was one way to triangulate data. Two participants (Si, As) were not able to identify a work-team they belonged to, so they only reported on their values and what they perceived to be company values. As has been outlined in identity theory, shared values are an indicator for group-identity (Adbelal et al. 2007, p.9), thus participants embedded in a group score high in compliance with this group's values. The comparison between perceived group or company values with personal values showed the embeddedness. The findings confirmed the individually reported group- and role-identity: there was a high covariance between reported values and the active identity of the individual. Figure 28 illustrates high value compliance, where 'high' is defined as complying in fifteen or more of twenty-two values.
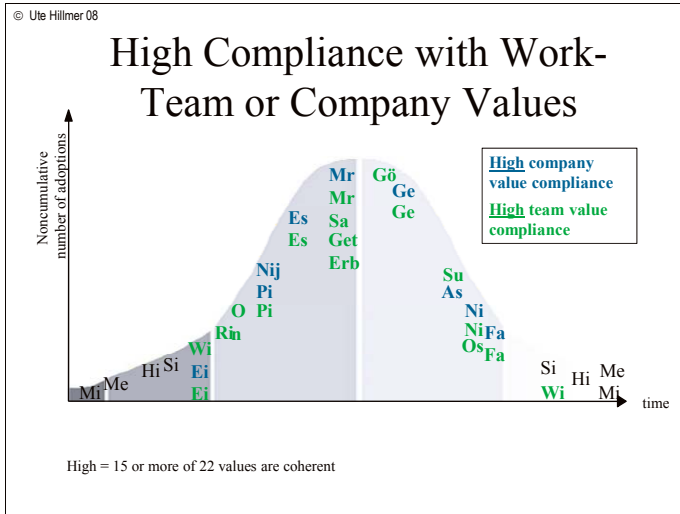
Figure 28: Compliance with work-team or company values

Analysing the terminology participants used in the semi-structured interviews, and in some follow-up discussions clearly revealed "identity language" (Abdelal et al., 2001, p.14) for some participants. The two participants (Mi, Me) located most to the right and left of the chart, strikingly often used 'I'. The following two participants (Hi, Si) were still predominantly speaking from an 'I'-perspective. In contrast, various group-embedded participants answer in plural, even when asked about their personal opinion.

When analysing the participants' information sources and the preferred communication network, the typology was confirmed. Important and intensive in-group communication classified as narrow but strong network ties (Granovetter 1983), stands for high group-identity. In contrast, participants with a central role-identity communicate differently: they maintain wide and loosely knit networks to sources mainly outside the team and the company, a low-density network of weak ties. These relationships confirm Smith-Lovin's theory (2007), that "all three types of identity – role-identities, group membership, and differentiating characteristics [personal identities] – have networks at their source." (p.110). It further emerged that cohesive ties, based on job related friendships had a particularly strong impact on technology adoption behaviour. Figures 29 and 30 illustrate the relationship between role- vs. group identity and network ties.
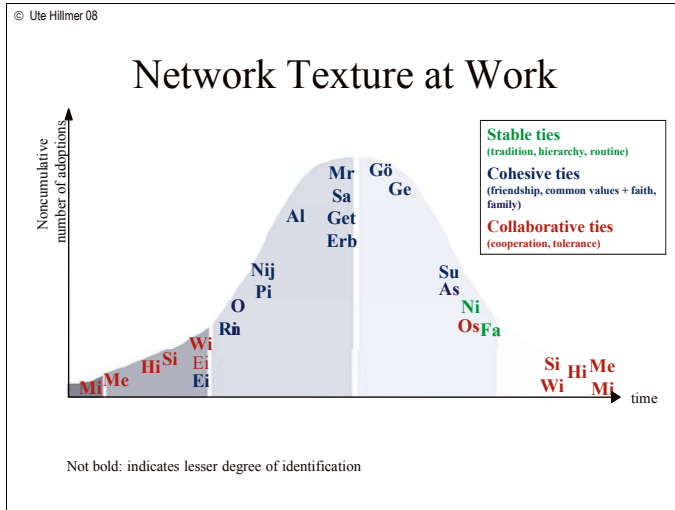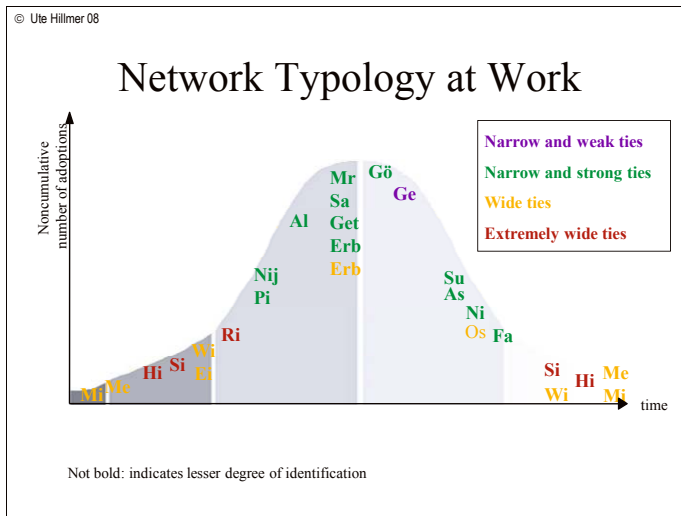
Figure 29: Network texture at work

Figure 30: Network typology at work

Additional support for the typology came from the questionnaire based investigation along Jung's (1921) personality types, which are also part of Kolb's (1984, pp.41-2) learning types. The distinction between extravert and intravert types emerged to resemble a predominant role vs. group identity. The extravert

type, described by Jung as "his entire consciousness looks outward to the world, because the important and decisive determination comes to him from without." (1921, ch.X, B), captures all participants with a central role-identity, as illustrated in Figure 31; while the introvert types capture participants with a strong group identity, as illustrated in Figure 32.
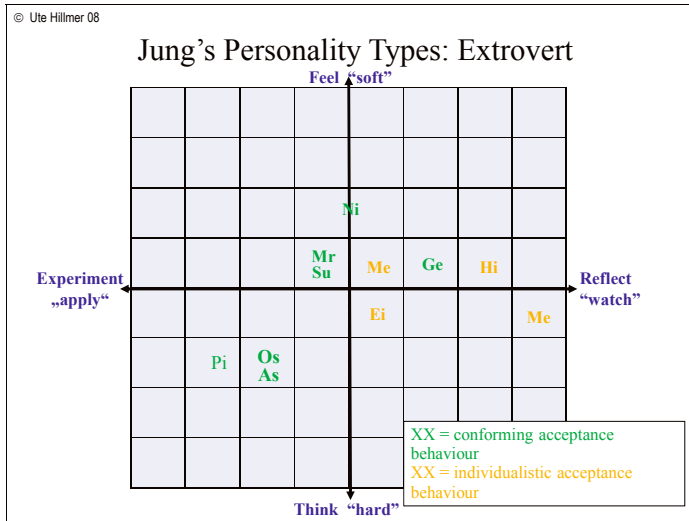

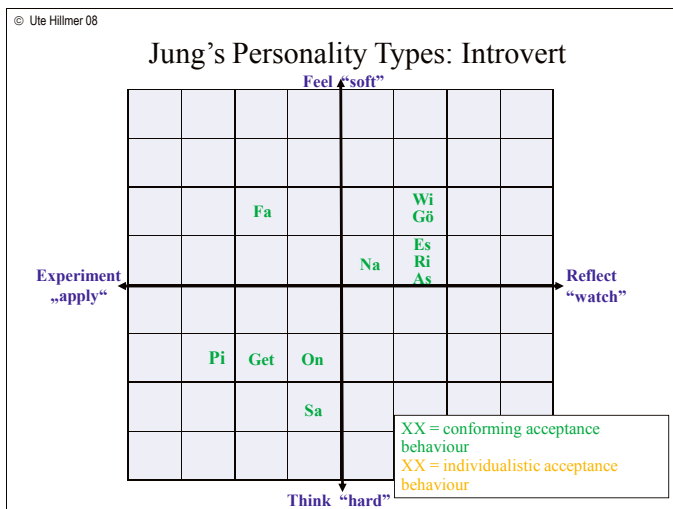Figure 31: Jung's personality types: Extrovert

Figure 32: Jung's personality type: Introvert

Figure 33 offers a graphical illustration of the triangulation that emerged from the various methods used in the interviews and questionnaires.
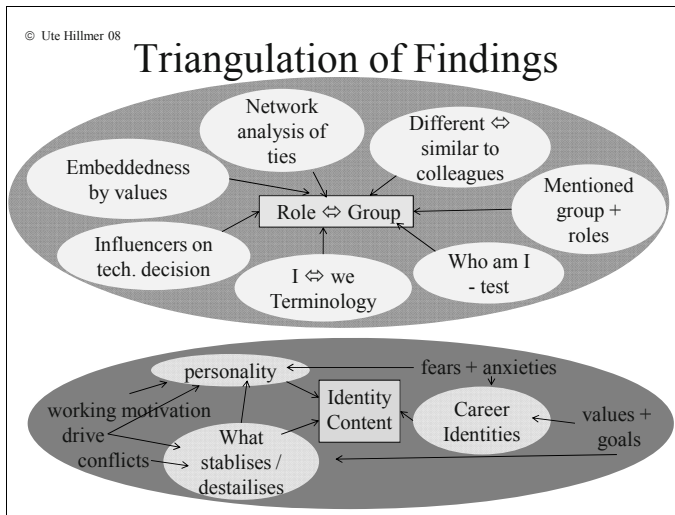

Figure 33: Triangulation of findings

9.6.5 Company culture and group identity

In this research, technology acceptance behaviour did not emerge to be in relationship with organisational cultures. This research reveals that different participants within one organisation perceived their organisations' culture differently.

Employees' Classification of Org. Cultures

	Power Culture	Role Culture	Task Culture	Person Culture
Company Culture	Nij Os Fa Es Ri	Wi Pi (Me) Mi Sa (Sei) Get Gö Su	Mr As Hi Me Ni Gö (Ja) Sa Ge (Hil)	Sa (Schn) On (Am) Ei
Work-team Culture	Ni Os Ni Es Ri	Mi Pi (Me) Get Gö (Sei) Fa	Mr Hi Su Me On Ge (Ja Gö As (Am)	Sa (Schn) Ei (Hil) Wi

Each colour represents one company and work-team   (xx) = individuals that answered questionnaire, but were not interviewed

Table 8: Employees' classification of organisational cultures

Among the seven companies participating in the research, the multinational, major corporation was the only one, which was uniformly categorised as a role culture by the three employees that were interviewed. In all other cases, the perception of company and work-team culture did vary per company on average between two to three of a total of four types of cultures. The data is summarised in Table 8, where each colour represents one company and work-team. There was also no relationship between perceived culture and group-identity.

9.7 Self-concepts concerning learning and influence

A correlation between technology acceptance behaviour and self-concepts of learning and perceived influence emerged.

9.7.1 Learning style
This section addresses the perceived ability to learn, the desire or reluctance to address something unknown, and the resulting consequences for new technology adoption.
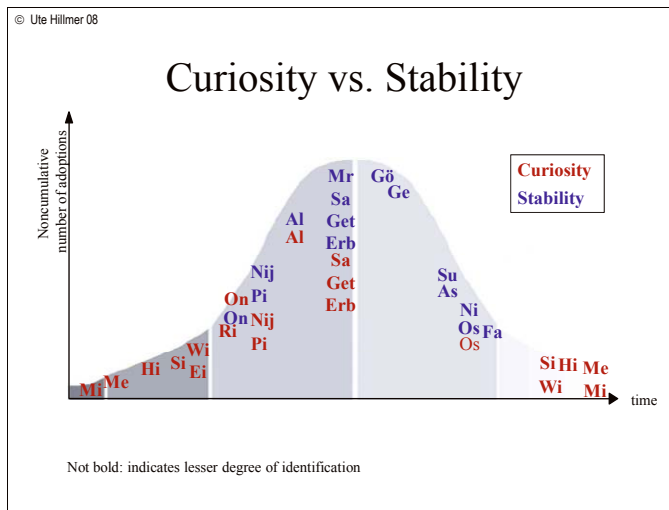

Figure 34: Curiosity vs. stability

The research data indicates that the earlier a participant adopts a new technology, the more this person is driven by a curiosity for something new. This urge was described as a 'drive' with an unknown origin. "I guess it is in the genes, my son is just the same" (Me) was one explanation offered. This drive was found in participants all the way to the climax of the curve. The strength of this curiosity varied. It is extremely obvious in participants to the far right and left in the curve (Me, Mi, Hi, Si), however, there are selected participants (Ri, On, Sa, Get) that also

are high in curiosity but they adopt technology in the majority section. The content these participants were curious about varied and is further addressed in the section analysing the content of an identity. Just as a curiosity for something new emerged, a need for stability emerged for some individuals. Figure 34 illustrates the "curiosity vs. stability" findings.

There is a negative correlation between those participants who value 'stability'. While 'curiosity' vs. 'stability' seems to balance out in the central area of the curve, stability without the mention of any curiosity dominates at the tail end of the conforming segment. These participants did not mention any form of curiosity as a motivator and they did not seem to relate positive to learning.

Probing for Dweck's (2000) differentiation between "master learner" and "helpless learner" (p. 15), and Argyris and Schön's (1996) model I and model II learning, the picture became more complex. There were few clear "master learners" in Dwecks' original definition among the interviewed participants. It collided with the need to 'not look too stupid', which was present for all but one (Ri). The argument was the necessary 'company image towards the customer' (Si, Sa) and to a lesser degree 'the image in the team as a supervisor' (Me, Si). The drive for 'master learning' was also downscaled by the need to 'serve the customer' (Sa, Get, Erb) and 'to serve the company' (Ei, Ri, On). Furthermore, there were 'efficiency goals' that attenuated 'master learning'. However, whenever company needs matched a master learning interest of an individual, they were more than happy to explore something new.

In contrast, "helpless learners" (ibid.) learn something new because "it is expected" (Su) or "it comes with the job" (Ni). Motivation for learning is external to the participant and learning is avoided if no negative consequences follow.

9.7.2 Having influence on the external situation

Decision processes varied between the different organisations. Consequently, different participants were involved in technology decisions in different ways. The researcher did not quantify this variety; it is the subjective perception of each respondent concerning the decision and implementation process, and his individually perceived involvement for which data was developed.

One can divide the emerging data concerning an individual's perceived influence on the situation in two categories: there is the perceived ability of the participant to change oneself, in other words to learn or to adapt in one way or another to the situation. Alternatively, there is the perceived ability to change the situation rather than to change oneself. These two factors emerged as being distinctly different in their consequences. Within the category of participants that think they can change a situation, two different behaviours emerged. With those who think they have no influence on the situation, three different behaviours emerged. Overall, five different categories were identified and compared to technology acceptance behaviour.

The first is the behaviour of those participants (Mi, Me, Hi, Si) who think they can change a situation and who want to change it. These participants value their personal opinion and judgement, they engage in individualistic behaviour and are either to be found early in the adoption curve actively pushing a technology, or very late, to the point where they refuse a technology. In unison, the respective technology was instrumentalised as a means to achieve a personal goal or to maintain or boost a central, individualistic self-concept, independent of technological features and benefits. "…if I'd be really honest, it was never about this XY technology. This technology promised to get attention within the network, I was able to speak at conferences, get into the press… . This was all about me!" (Hi). "When we use this new technology, we automatically offer our customers new, state-of-the-art technology, too. This gets us ahead, even ahead of our sister company." (Si). These participants take it upon themselves to influence a situation towards what they perceive as beneficial to them individually; to their personal goal. For Mi and Me, technology was a means to get ahead of anybody else; they were determined to use the technology that suited their work-goal most and they could not agree to just 'join in' with the crowd. In these two particular cases of technology rejection, both Mi and Me independently used the rejection as a way to measure their power and influence against their direct superiors. All four participants had their own agenda, which usually also was said to benefit the company, and they did not care about any 'common opinion', unless this opinion influenced their personal goals.

Independent from each other, high emotional reactions were observed, when two participants in this category (Mi Me) were confronted with a situation of technological change were they were meant to conform yet they disagreed. Both had significant problems with this situation. For them, rational means became secondary; anger and rage dominated consequent behaviour, along with the sensation of instability. Arguments and justification were highly emotional: "pure stupidity" (Mi), "ignorance" (Me). Both participants tried to force their ideas on the situation, boycotting the technology, determined to proof that their idea was right. Me succeeded up to the point of the research but reasoned that he would eventually have to give in; Mi had to give in, but continued to engage in open resistance whenever possible. They both seemed ready to live with any consequences, and entertained the thought of leaving the company. One of them is seriously looking for job alternatives.

Further, there is the behaviour of participants who believe that they can change the situation, but do not intend to insist on it, because "there are more important things to take care of" (Sa). They have other higher priorities and the technology in question is a tool to get a job done. "If a customer wants me to use a particular tool, I'll use it" (Wi), "I need a tool to work with, … to some degree they are all similar…each one has its strength which usually also comes with a downside." (Get). These individuals all adopted technology at the average point of adoption,

going with the flow and concentrating their energy on what they considered to be more important things.

Then there are participants who perceive they have no way to change a situation of technological change, and the largest group in this category are those who surrender to the situation: "technology is a tool given to me to do my work; I have to accept this" (Nij). Few others voiced their discomfort that they were impotent (Su, Os, Fa). Notably, this group of participants is very late in adoption of new technology.

Two participants (Fa, Os) within this category worked whenever possible against using the technology, but kept this hidden. These participants did not openly reject the technology, but they always found new reasons why using the new technology in the project at hand did not make sense. This behaviour was perfectly acceptable to the two participants. They found logical verification that worked for them, but they were aware that they avoided the new technology.

They both wanted to do a good job for their company, because they felt it was their duty, but the new tool was "just not right for them". They both felt they should be allowed to design machines the way they fine-tuned the process for them personally. New tools lacked the quality and the special attention that they both argued to have developed in their personalised design processes. They did not feel that their personalised process way was right for everybody, but the company would lose their valuable contribution when they would merge to the new process, introduced by a new technology. "Why do they not ask about proven work methods?" (Fa) is a frustrated comment, directed towards application vendors. Os described in detail how critical details sometimes get lost in the data conversion process towards a new design tool. Since his past designs were valuable sources for his future designs, he rather stayed with the old design tools to ensure efficiency and quality (Os). Both participants blamed changing values, where efficiency became more important than quality work.

Last in this category is the behaviour of one participant (Ni) who subconsciously was against using the new technology, however, through various comments it became apparent that he was not aware of an acceptance behaviour that was categorised by his supervisor as "avoiding to use the new technology whenever possible". Ni claimed he was happy with the new technology whenever 'his special method' was not needed. Contradicting himself, he said that there are "many ways in machine design that all lead to the desired end. I know many of them. One tool supports one way; another tool supports another way. There is not really a significant difference…. It is a matter of personal preferences and what's en vogue. … so I use what they give me." (Ni). The spectrum of behaviour is illustrated in Figure 35.
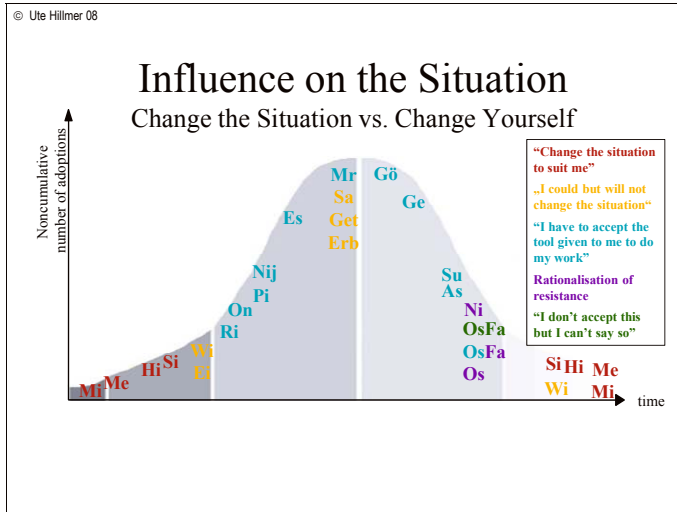
Figure 35: Influence on the situation

9.7.3 Involvement in the decision making process

The perceived involvement in the decision making process for a new technology is related to the perceived influence on a situation, yet, it offers different insights, as the emerging data will show.

There is a relationship between early adopters and perceived decision involvement: all but one (Ei) feel they have been involved in the decision; Ei had the perception that if he had wanted to, he could have been involved. This correlates with the findings regarding the self-concept of having influence on a situation. When looking at the rejectors, they all had the self-concept of influence, too, but not all perceived that they were involved in the decision. Mi was not involved but had the perception of influence on the situation by open and complete rejection.

9.8 Emerging identity content

This section addresses the meaning inherent in participants' central identities at work during a situation of technology adoption. This identity content has emerged as a strong indicator for the perceived stress or excitement that a new technology will elicit. It does not only offer deeper understanding about those participants that behave individualistically and those that conform, it also offers understanding for the actual point in time, when a 'conformer' is ready to adopt a technology to its full extend. The content of an identity is defined as the values, beliefs, goals, norms, needs and morality of an identity. A typology of six different identity contents emerged, that are not mutually exclusive.

9.8.1 Identity rooted in technical competence

Twenty of the twenty-two interviewed participants currently hold a central identity of technical competence; the remaining two (Hi, Si) have scaled down this identity over the past ten years, and replaced it with an identity of managerial competence or managerial challenge.

All twenty participants mentioned a high identification with technology, pride in their engineering and design capabilities and the work they do, and all but one (Fa) mentioned the joy of feeling challenged by technical problems. Such an overall high degree of technical competence identity is likely to steam from the selected industry sector and the professional group. A technical competence identity is probably equivalent to a machine-design job identity.
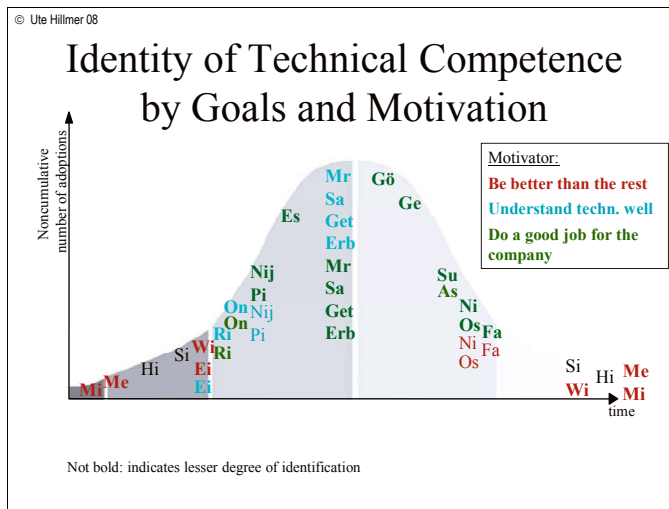

Figure 36: Identity of technical competence

However, the goals and motivations within that identity vary and three distinct groups emerged. Figure 36 illustrates this. For those participants who accept the particular technology very early or not at all, the technical competence identity is a role-identity in the sense that they perceive their technical competence as higher than the competence of other people around. Still early, but within a range of conforming, mainstream behaviour, participants who think of themselves as having specialist knowledge in some areas, or who perceive themselves as quicker learners, can be found. However, this group in parallel is driven to do a good job for the company.

At the peak of majority behaviour the motivator of 'understanding technology well', disappears. Furthermore, all participants within the 'mainstream', conforming section agreed that new, disruptive technology has a direct and

significant influence on doing a good job for the company. Any new technology brings down efficiency and quality in the short term, because it requires time and energy to learn how to handle it and to become familiar with the new workflow and changed processes. However, they also agreed that unless something goes wrong, technology is a tool to help submit good work and it will enhance efficiency or increase quality in the end. The talents that seem to go along with these values, goals and drives are technical sophistication and perfectionism.
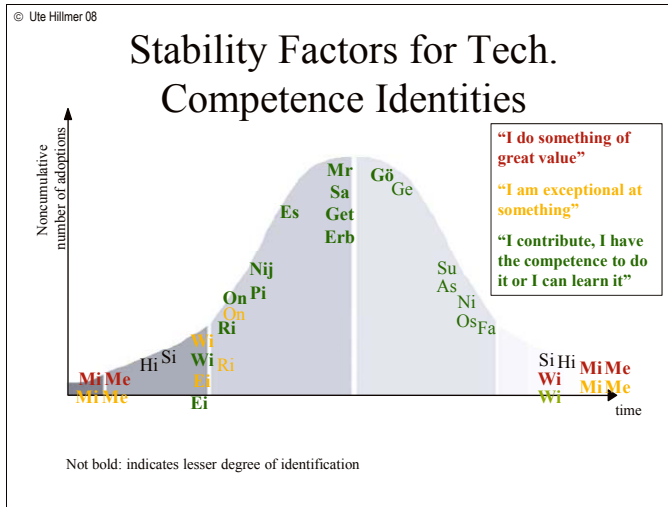

Figure 37: Stability factors for tech. competence identities

Participants with an identity in technical competence gained stability and a sense of security through their competence and knowledge. The feeling to be able to cope with their work challenges through experience and existing or additional knowledge was crucial for them. Being efficient as well as willing and capable to work hard were additional stabilising factors to the point where status based on luck or chance seemed unworthy; success through hard work was desirable. These participants wanted to be respected for their work. Figure 37 visualises these findings.

A decrease in the need for special recognition for one's competence emerged when moving forward on the adoption timeline up to the mean, from where on, the need increases again. A feeling of uncertainty and insecurity prevailed when technical competence and knowledge were questioned by others or by themselves. This scenario appeared in various ways: when the complexity of the technology that must be designed is overwhelming, when the feeling of lacking professional competence prevails, when there is not enough time to do a quality job. "Lacking a sense of technical direction" (Nij) or even more simple "not knowing something"

(Get), sums up the temporary instability, giving way to unease and self-doubt. Again, Figure 38 gives a visual impression.
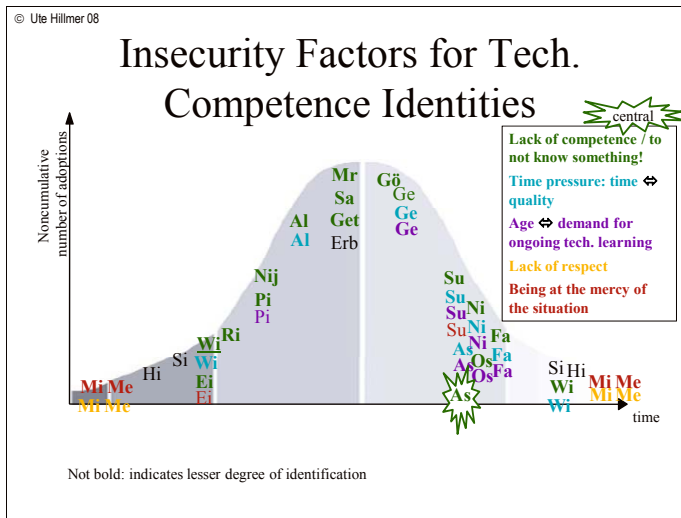

Figure 38: Insecurity factors for tech. competence identities

In summary, time pressure that sacrifices quality, facing an ongoing demand for learning, lack of respect by others and being at the mercy of the situation were repetitively mentioned factors of concern for this identity.

Furthermore, many participants, anchored in technical competence mentioned their discomfort about aging, and what that meant for their technical competence. All participants above the age of 50 (Gö, Ge, Su, As, Ni, Os, Fa, Erb) were concerned, but even some participants in their mid 30s (Pi, Nij) voiced the concern. In contrast, none of the individualistically operating people mentioned age as a concern.

Perceived incompetence is the area, where new, disruptive technologies destabilise. All competence grounded participants mentioned that in order to become efficient with a new technology, one needs time and experience. However, time is a rare commodity in machine design and any project usually runs late, so there is no extra time 'to play with a new technology'. "Using a new design technology, you don't even know the most simple procedures – you feel like an complete idiot!" (Ri). Equally often mentioned is a trade-off between time and design quality. While new technology required extra time to learn how to handle it, this time was lacking, thus the design quality suffered. Most respondents agreed that new technology always results in temporarily lower quality work.

The identity for technical competence usually came along with one of three additional, parallel identities. There were those who had an additional drive for

technological or managerial challenge. Others were dominated by the need for a work life balance and yet others were driven by a need for stability and security.

9.8.2 Identity rooted in managerial competence

Hi and Si used to have technical competence identities, but project leadership and management tasks moved them towards an identity of managerial competence. Technical capabilities became secondary for them, and today, they are proud of managerial capabilities instead. Communication, individual networks, and working for and with people became their increased focus. They both had the goal to be better than the rest, and they wanted it to be recognised. In this sense, their managerial identity was dominated even more by an identity of managerial challenge.

9.8.3 Identity rooted in technical or managerial challenge

All participants who accepted a new technology very early emerged to be driven by the need to meet new, extraordinary challenges. Furthermore, they were highly competitive, which means they wanted to do something that had not been done before, and that was not easy to do; yet they wanted to be measured and recognised.
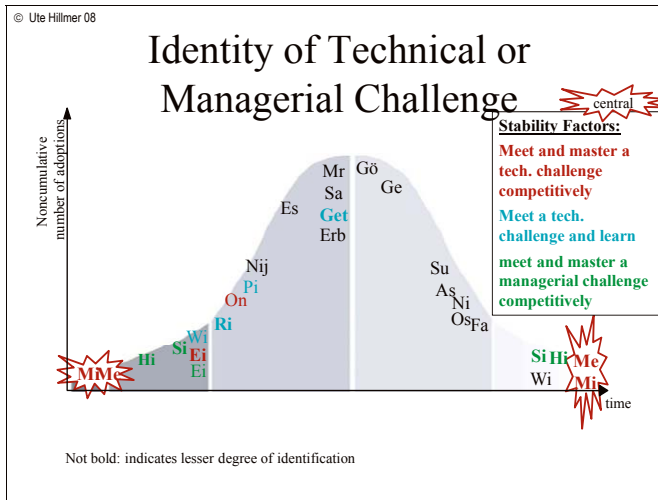
Figure 39: Identity of tech. or managerial challenge

As Figure 39 illustrates, two participants (Mi, Me) insisted that they are technologically superior. They described themselves as highly competitive, perfectionists, dynamic, innovative, impatient, clever, yet they were judgemental. They highly valued their superiority, and seemed to live on the credo 'whatever it is, I can do it!'. Hi, Si and to a lesser degree Ei were similar to Mi and Me, but the subject of excellence was not technology but management; to 'manage the situation

– whatever it is - was the challenge to be met through "solutions with and for people" (Hi).

The goal was to stay ahead of the competition, and to gain recognition for their achievements. Mi and Me spoke proudly of the many patents they personally held. All challenge identities were motivated by doing what nobody had tried before, by competing and by winning. Feeling respected by others for their technical or managerial cleverness seemed to be an integral part of this identity. To meet challenges, to master them, and to be recognised for them, was what defined these identities and what stabilized them. Doing something valuable, something "good for humankind" (Mi), was mentioned by Mi and Me as an important goal in life.

Me's self-concept was diminished by the fact that his opinion was outweighed in a new technology selection process. Mi made the same experience when he was not even involved in one technology decision process. As described earlier, on both occasions, rationality shut down and irrational action, arguments and justification prevailed. Three participants (Mi, Me, Si) mentioned unfairness and ignorance as a foremost destabilising factors.
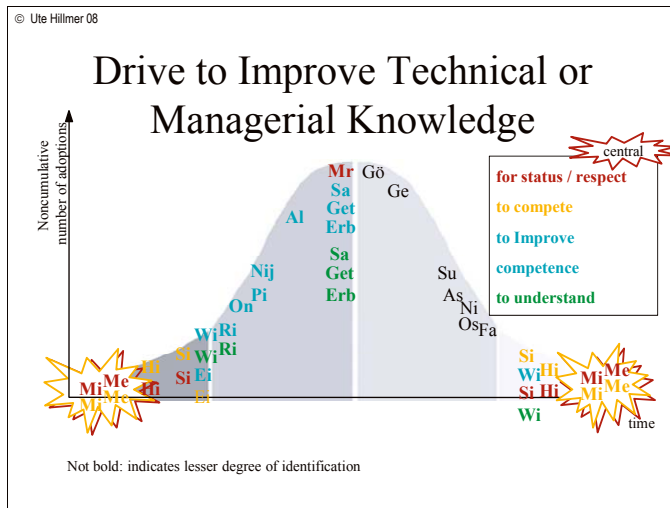
Figure 40: Drive to improve technical or managerial knowledge

Two more participants (Ri, Get) had a central identity of technical challenge, however, with a different twist. Their identity could be called a 'technical knowledge challenge' vs. a 'technical competitive challenge' described earlier. The underlying goal was to discover something new, understand something further for its own purpose, not for recognition. While the previously mentioned participants needed an audience for their performance, these two participants had an intrinsic motivation: "if an idea does not work out, this doesn't matter, it is interesting to see

why it did not work." (Ri). Meeting a new technological challenge, further understanding technology, playing with technology and discovering if it is useful, are the goals and motivations behind these individuals' behaviour. They were lackadaisical about success and failure. Ri was thought of as "the most creative designer in the team" by his supervisor – this was the sort of compliment that made Ri proud. Figure 40 illustrates the different motivations behind improving technical or managerial knowledge.

When asked about their interpretation of how this world functions, the surprisingly unison answer of the two 'technological competitive challenge' driven participants that do not know each other, was: "money makes the world go round" (Mi, Me). Whereas the knowledge driven two both mentioned the importance of other people: "With fairness and goodwill, you can get along with everybody" (Get) or "It only works in a team" (Ri).

Other participants (Ei, Wi, Pi, On, Erb, Sa) mentioned aspects of a technical challenge identity, however by no means was the identity as distinct and competitively driven as the participants mentioned before. They acknowledge their love of technological challenges, but immediately came up with reasons why following this drive does not make sense any more. Instability for the competitive group was associated with "not being efficient enough" (Si), not knowing something (Me, Hi, Si) or "having made a wrong judgement" (Hi).

The technical and management challenge group differed in how they solved their challenges. While the 'technic-centric' (Mi, Me) focused on their knowledge and creativity, their 'management' counterparts (Hi, Si) turned to their network to find solutions. A similarity between Hi and Si was furthermore their way to cope with immense stress: they mentally shutdown whole areas simply ignored them. "It is like closing a window in windows, it is no longer there. But you know that you can open it any time again" (Hi). Both participants also reported that in their experience time also solves problems. In contrast to Mi and Me, they had acquired an understanding that they cannot influence everything. Thus, managerial challenge identities came across more emotionally balanced. This was reflected in their philosophies of life: "Everybody has his own interests" (Si); Hi thought it important to "contribute something each day", however, "what will be, will be" (Hi).

9.8.4 Identity rooted in security and stability
Six (Ge, Su, As, Ni, Os, Fa) participants can be grouped together, because identity characteristics that value and aim for security and stability united them. Six more (Nij, Pi, Es, Mr, Sa, Gö) more hold aspects of this identity, combined with other identities, as Figure 41 shows.

For these participants, employment security, work routine security, financial security and geographic security emerged as needs that they would not compromise. Furthermore, it was important "to function well" (Su) within the workflow or hierarchy. Having and keeping a safe job ensured a stable income to

manage with, which was perceived to ensure stability. "I have to do my "share of the design well" (Ni), and to give their company 100% (Fa), because "the company comes first" (Su) were typical comments from this group. They were ready to give complete loyalty in order to receive loyalty back; to give good work for good money was the underlying moral based motivation for all of them. Individual personality had second priority for this group. One reflected on this and voices a degree of discomfort (Ge), the majority however took this priority for granted as something natural.
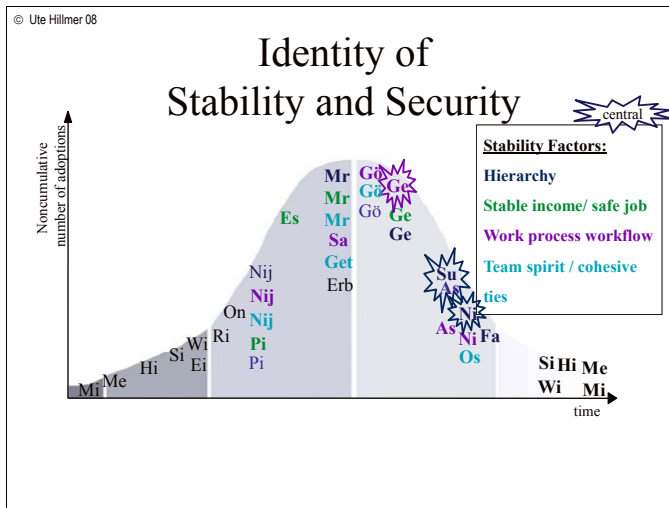

Figure 41: Identity of stability and security

The identity at work was fully embedded into either the working hierarchy within the work team or company, or within the workflow. This hierarchy or workflow gave stability: "hierarchy gives respect and self-respect" (Mr), hierarchy resolves problems and conflicts (Fa, Su, Ge), and workflow clearly points to what job to do next, what documents to submit and who's requirements to meet at what time; it clearly structures work, it "is a guideline and a yardstick" (Ge).

For one participant (Ni), who spent his childhood and youth in communistic Poland, questioning hierarchy and the existing structure was beyond imagination. There was a "boss" and a "bossboss" (Ni), and they were always right. This hierarchy is more than anything, an integral, irrevocable part of this individual's world.

In contrast, some other participants (Nij, Mr, Get, Gö) gained stability not so much through the formal hierarchy but through cohesive ties of friendship within their working structure. This emerged as a more flexible and dynamic anchor for a

stability and safety identity, and these participants adopted technology earlier, which is reflected in the adoption curve.
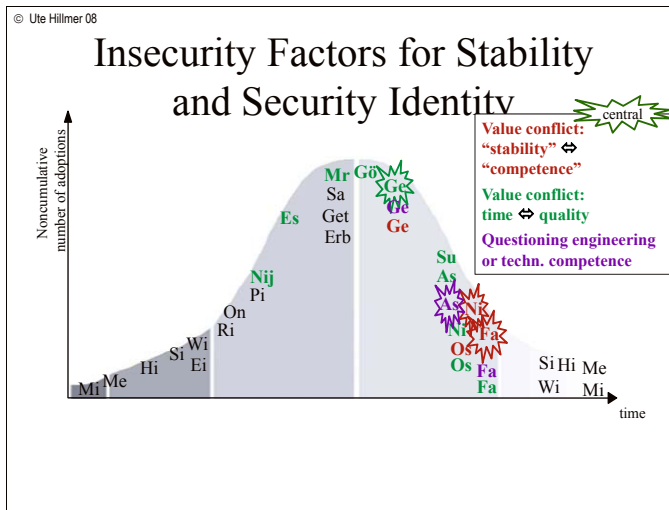

Figure 42: Insecurity factors for a stability and security identity

Technological change destabilised this group by various means that are shown in Figure 42. There are notable distinctions between the participants within this category, especially when analysing the factors that stabilise and those that take this stability away.

Of all participants in this category, four (Pi, Es, Mr, Su) explicitly mentioned the importance of having a save financial income over and above their professional identification and their integration into the organisational structure. Of the four, two mentioned their personal experiences with unemployment and both saw job security as most stabilising. Another participant (Pi) came from a poor background in former Yugoslavia, and he did not want to experience poverty ever again. For all of them, technology played quite a significant role in their lives. While two viewed technology as a means to increase competence and thus marketability within the job market, one had experienced obsolescence of technology in his family. Thus, he was watching any negative influence that technology might have on his life.

Instability through organisational structural changes emerged for As and Os and they both seemed to be immersed in the structure. Keeping a low profile was As's way of ensuring job security. He was highly irritated that he had been singled out for an interview, as indicated by the slight shaking of his hands at the start of the interview. Both As and Os were concerned about recent rumours about re-locating parts of the factory floor however, management indicated that the rumour was unfounded Nevertheless, trust in the organisation was compromised thereby

causing the issue to arise continuously. The uncertainty about being able to trust was obviously destabilising, and Os used sarcasm to cope with this distrust, however, As was completely enervated.

9.8.5 Multi-identity rooted in a balanced life

Some participants (Ri, On, Pi, Nij, Mr, Get, Ni) indicated that they were well integrated in multiple identities not necessarily directly linked to a working context but all the same central to the individuals in a way that it was a part of them at work.

Participants who engaged early in conforming technology adoption mentioned at least two additional, non-work related central identities that were critically important to their well-being, because they gave balance to their life. It was an integral part of their self-concept. All participants who conformed mentioned at least one non-work related identity that helped them at work. "It is good to have something else that is important … one tends to not take problems at work too seriously" (Mr).

Furthermore, all participants but one (Mi) mentioned some "non-work" related stability factors that they perceived as important, and they all pointed out that if they did not have them, their work would suffer. Family was among the most often mentioned aspects, however only two participants (Pi, On) repeatedly referred back to family when talking about themselves.

For participants with a multi-identity of balance, the conflicts that emerged in respect to new technology revolved around time and loyalty. Participants felt insecure when they had to set priorities between central identities that demanded identical time slots. Most often, they reported to feel disloyal to other group members they had to defer.

A distinct common nominator for them was their world-view. They were rather calm about the things happening immediately around them. They felt to be part of a larger system, where they had no direct and immediate influence, because "the world runs its course with or without me" (Sa). Additionally, they all shared the belief that one is more successful in life in a team than alone. Figure 43 illustrates the spectrum of central stability factors at work.
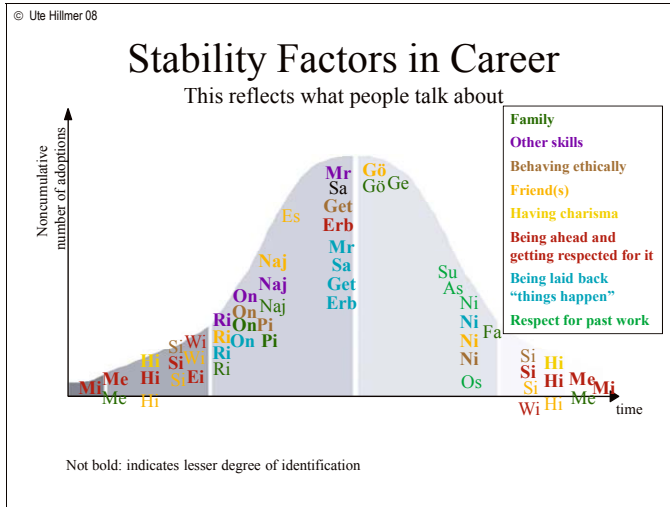
Figure 43: Stability factors in career

9.9 The role of age in technology adoption

Age has already been reported as an instability factor for participants that identify highly with a technical competence. They worry that they might not be able to cope with new technology, as they grow older. "I am an engineer, I have to understand technology, …have to be pro-technology, … unfortunately technology is getting faster than I am" (Ni), this quote describes the dilemma of two incompatible identities. As another participant puts it "We are developing new technology; technological change comes with the job" (Si).

All the participants who felt "older" were in the late majority section of technology adoption, and behaviour has been observed that suggests two distinctly different ways of coping: a conscious self-verification of technology reluctant behaviour and an unconscious agency against using the new technology. As one participant put it: "many working years of experience accumulate in high working efficiency through individualised processes" (Ni), which they rationalised as inefficient to unhand. All four participants agreed that the new technology might be great for some particular aspects, but that it did not hold the overall high promises. 'Not everything old is bad' (Ni, Os, Fa) became a repeatedly stated position.

Another phenomenon related to age emerged from questionnaire-based answers along with the answers given within the first 5-10 minutes during the interview and the comparison with data gathered later during the interview. The first set of data indicated that the young participants were more concerned about new technology than the more experienced, older workers were. The younger generation mentioned

that technology is not just all positive; that it takes a lot of effort to learn it, and that expectations might be too high. "They give you a screwdriver, but you still have to tighten the screws yourself." (Ri). In contrast, participants prior to age 55 communicated an overall very positive picture concerning their assessment of technology. During the course of the in-depth interviews however, a discrepancy emerged: most of the older designers started the interviews with answers like 'I can't think of anything negative about technology', but they later admitted a range of worries and stress, technology caused them. Consciously or subconsciously, the 'older generation' suppressed the negative side of technology in first answers.

9.10 Mechatronics
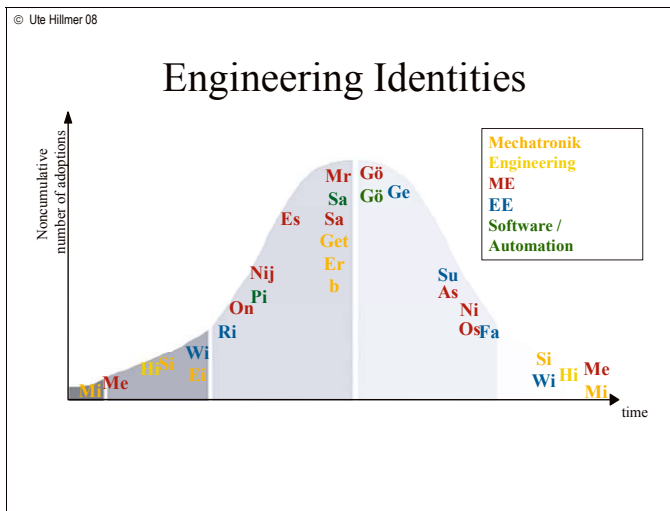
Figure 44: Engineering identities

Within the mechatronics design discipline, three to four different engineering disciplines work together. The mechanical engineer, the electrical engineer, to a lesser degree an electronics engineer[8] and the software or automation engineer. New technology has many effects on the young discipline, and emergent data allows for some further insight. First and maybe most important, there has not been any correlation between technology acceptance behaviour and the different engineering disciplines. Individualistic behaviour, rejection vs. endorsement, and early or late conforming behaviour came from all engineering disciplines,

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[8] The electrical and electronics design is often found in personal union in the machine construction industry in Germany.

whenever there was a significant sample size available, as can be observed in Figure 44.

Furthermore, preferred information formats were investigated, and the analysis showed an overall preference of graphics and charts by most participants. Mechanical engineers scored higher on 3D visuals; for electrical engineers, flow charts were of higher importance than for other participants. Overall, no clear and distinct preference between the disciplines was found.

10. Discussion and Implications

10.1 Introduction

This chapter discuses research results and their effect on existing knowledge. It lists the deficiencies that emerged during the study and the emerging implications for improvement in theory and practice. The purpose of this study was to investigate the role of social and individual influence on technology acceptance behaviour. This was done by investigating an individual's subjective interpretation of the situation of technological change.

The results of the frame analysis indicate that understanding the identity content of an individual serves as a navigation system towards individuals' meaning systems. This assumption was confirmed by the data that was analyzed from this study. Once an individual's meaning system can be understood through the content of its central identities, one can make sense of this individual's behaviour in the context of technological change. Distinguishing between a central group-identity vs. a central role-identity helps to determine behaviour being predominantly individualistic or conforming.

The system can be understood most effectively through the factors that stabilise an individual's work identity vs. those that destabilize. While these factors emerge as individually unique, they can be partitioned into various, overlapping typologies that emerged as typical for the analysed mechantronics designers. Comparing a new technology's qualities with an individual's unique factors that evoke feelings of stability or instability gives a lot of insight into technology acceptance behaviour.

10.2 Discussion of early acceptance vs. technology rejection

Within the analysed group of participants, those who reported an early technology adoption were the same individuals who also rejected a technology. This finding is significantly different from existing knowledge that was discussed in part I. Adoption theories have used 'innovativeness' as a relatively stable personality trait, introduced by Rogers (1995, p.252) and followed by Moore (1999, p.12). Existing models identify no correlation between what has been described as "innovators" or "early adopters" and "laggards" (ibid.; Rogers 1995, p.265); these categories were considered personalities with a different and relatively stable mindset towards technology.

The emergent data in this research leads to a different understanding: participants who actively pushed a new technology or who rejected it, felt in control of the situation and insisted on the right to act according to their individual expert opinion concerning a particular technological change. This opinion was dominated by their personal interest, which was often also beneficial for the company. Two of

those individuals were not granted the right to change the situation, even though they thought they should. They both felt personally offended and scorned, to the point where they reflected on the pros and cons of leaving the company.

This data, which contradicts existing theory, are significant, because they offer new possibilities of action that have not been considered before. Traditionally, laggards and rejecters have been ignored in marketing, sales and change management activities. They have been considered too much effort for too little benefit. However, these findings indicate that fast and enthusiastic technology endorsement might be applicable by modifying the situation slightly but creatively, so these individuals attain a personally relevant benefit.

This finding however, might be industry and profession specific. Rogers as well as Moore describe technology rejecters as individuals who qualify as "technophobics" (Brosnan, 1998, 1999). This research did not discover any form of technophobic behaviour, which is characterised by a rejection of technology in general. Technophobics are not likely to alter behaviour between rejection and early adoption. The lack of technophobics in this research must presumably be attributed to the overall engineering identity of the sample. All participants are in the business of 'inventing technologies', they are educated in an engineering profession and thus, they are likely to be positively to neutrally relate to technology in general. This would be in accordance to social psychologies understanding, that individuals seek the environment that allows them to express their identities (Smith-Lovin 2003, p.167).

10.3 Discussion of central role- vs. group-identities

The results of the study acknowledge that society exerts influence on behaviour through various social identities. The influence becomes apparent in group- and role-identities that influence individual behaviour through normative and structural bias. Distinguishing between a central group-identity vs. a central role-identity help to determine behaviour being predominantly individualistic or conforming; this is illustrated in Figure 45.

Thus, central social identities offer a new perspective for technology acceptance theories, and valuable possibilities for practice. An even greater understanding emerged, when the degree of importance of the respective identity and the content of an identity were further examined, which will be discussed in a later section.

Participants, who saw themselves primarily as a member of a group at work, acted in accordance to their internalised group values and conformed in the working context. Motivations were manifold and could not be simplified to the point that they exercised conforming behaviour in order to remain a member. Various social and individual forces interacted and subsumed in feelings of belonging, predictability or meeting expectations.

In contrast, participants who held a central role-identity of 'being different' from the rest at work, behaved more individualistic in their reaction to new technology. These central role-identities usually came with an efficacy-based self-concept of being more capable or less capable of something in comparison to those around.
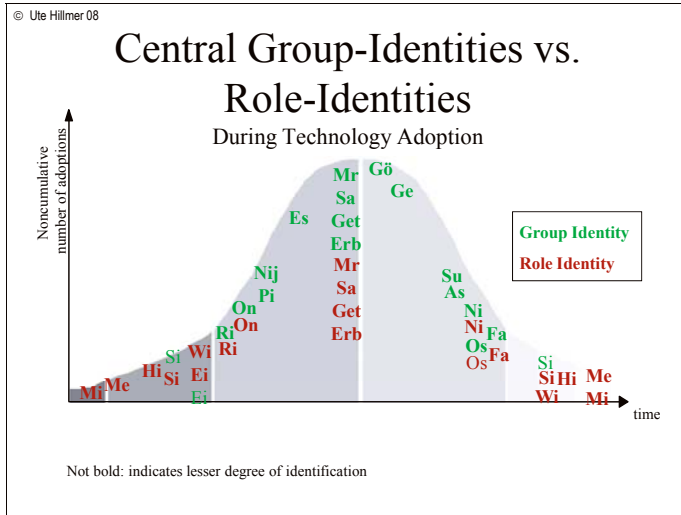

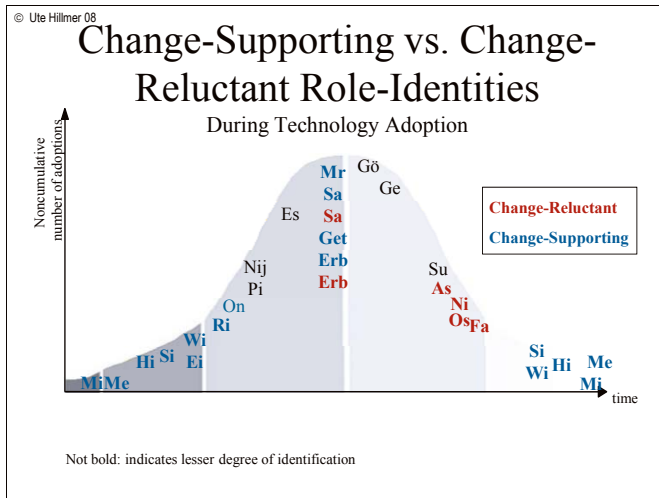Figure 45: Central group-identities vs. role-identities

Figure 46: Change-supporting vs. change-reluctant role-identities

This supports other research findings (Stets and Burke 2003, p.132) that describe a direct link between efficacy-based self-esteem and role-identity, which has been described in the individual perspective. In the situation of technological change, this translated into change supporting vs. change reluctant role-identities. Figure 46 visualises them.

All change reluctant role-identity holders had parallel group-identities. Thus, it cannot be determined whether the late but conforming behaviour resulted from their conformance supporting group-identity, from their change reluctant role-identity or from a mixture of both.

The change-supporting role-identities self-divide into two groups: Those who hold group-identities in parallel, and those who hold no group-identity at work. For individuals who hold both, a central group and role-identity with conflicting content for technology adoption, the identities seem to moderate each other. An individually unique hierarchy of identities emerged, dependent on the centrality of parallel identities.

All individuals who hold one or more role-identities without a parallel group-identity engaged in individualistic behaviour. Their motivation was not influenced by any group goal, and technology was purely an instrument towards a larger, individually important goal. This explains why these participants were willing to invest a lot of energy and willpower by adopting early and actively pushing a technology, and it explains the motivation to reject a technology. A new technology can serve or endanger goals, thus they choose to reject those technologies that do not qualify to support their needs and goals. A fair insight into the particular situation is required, as well as a high sensitivity for the individual and an understanding of the opportunities and threads inherent in a technology in order to make sense of the situation, as seen by these individuals.

The parallel activation of central change supporting and change reluctant identities neutralised each other and participants behaved within the conforming adoption spectrum, which confirms Stets and Burke's (2003, p.24) vector analogy of identities, discussed in the identity section. It was not quite clear if the choice of individuals that adopted at average was a conforming act or an individualistic choice. This issue will be discussed further in this chapter under the title of 'influence on the situation'.

According to data from five individuals at the turning point between individualistic and conforming behaviour and vs., the hierarchy of identities can change. This change progresses over multiple years, which confirms the cognitive-emotional personality theory (Mischel and Shoda 1995), introduced in the individual perspective.

Furthermore, strong non-work related group- and role-identities at work mediate work related role-identities and make an individual more relaxed about possible work related identity conflicts. This is in line with self-complexity studies (Smith-

Lovin 2003 2007), and in contrast to theories of the decentred, fragmented post-modern self (Welsch 1987, p.194, Keupp 1997, p.17); theories that have been introduced in the merged perspective. In the researched spectrum of mechatronics machine design engineers and technicians, multiple identities construct more complex selves that can better cope with situational stress.

Friendship ties within a group-identity constellation were more influential than any other forms of ties; a substantiation of network theories claim that the stronger the ties, the more influential is the respective group-identity (Keeton 1999; cited in Smith-Lovin 2007, p. 116).

10.3.1 Emerging theory concerning role- vs. group-identities and individualistic vs. conforming behaviour

A theory emerged which states that one or more active group-identities encourage conforming behaviour, while a central role-identity encourages individualistic behaviour. The parallel activation of both central group and role identities functions as ''vector additions'' (Stets and Burke 2003, p.24). These findings can be explained by the network interaction of group- and role-identities: The network tie is the connection to a group of others (Smith-Lovin 2007, p.110). Thus in groups, it is foremost the relatively fixed social structure that forms the content for identity. In contrast, role-identities' meanings are focused on agency (Stets and Burke 2003, pp.132-3)*;* they are a network relation with others that defines a position in a social structure (Smith-Lovin 2007, p.110). This makes a role-identity a dynamic construct, defined primarily through rights and responsibilities as well as behavioural expectations.
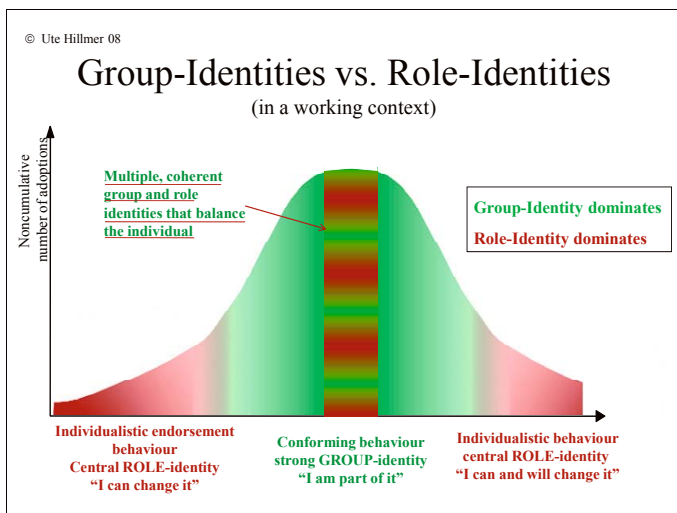

Figure 47: Schema of group-identities vs. role-identities

The correlation between technology adoption behaviour and predominant group-vs. role-identity is graphically converted in Figure 47. The findings confirm the appropriateness to use latest findings of symbolic interactionism based identity theory for a new and alternative perspective about the hidden relationships in technology acceptance behaviour.

10.4 Discussion of self-concepts of influence on the situation

A correlation between technology acceptance behaviour and individual's various forms of influences on the situation emerged. Changing oneself in the form of learning is one form of influence, changing the external situation is the other form that emerged.

10.4.1 Curiosity and ability to learn
A curiosity for something new and a willingness to learn and understand emerged for all individuals who adopted earlier or similar to the mean of the adoption curve. The strength of this curiosity stood out for those participants who engaged in individual behaviour. A few selected participants in the early mainstream emerged as equivalently curious but they had parallel, central group- and/or role-identities that attenuated the curiosity. Participants described this curiosity as a drive of unknown origin that is there or not there, and that cannot just be turned off.

10.4.2 Influence on external situation
Data emerged that indicates the importance of a participant's perceived influence on the situation other than their own learning. Participants with a dominant self-concept of "I can change the situation" were found either to take it upon themselves to influence the situation towards what they perceive as beneficial (which lead to individualistic behaviour) or they did not care to influence the situation, adopted at average, and can be found at the mean of the curve.

The difference between the behaviour of the two groups lies in the already discussed willingness to invest time and energy into turning the situation towards their edge. For individuals who engage in the second category of behaviour, energy was not wasted on something they perceive as less important.

10.4.3 A discrepancy between self-concept and situation
A discrepancy between a self-concept of "I can change the situation" and the actual influence on the situation resulted in high emotional stress, and individuals developed various means to protect their self-concept and their self-esteem. Along the same line is the perception that one should have been involved in the decision. The detailed dependence between the variables 'being involved in the decision', 'a self-concept of being able to change a situation' and 'technology adoption behaviour' is complex and cannot be revealed in this research. However, two individuals had the perception they can change the situation but cannot. Of the two, one was involved in the decision, the other was not and they both did not get their

way. Both reacted similarly, and were heavily emotional and self-protective. Consequently, it is likely that in this category, decisiveness rather than involvement influenced behaviour.

10.5 Discussion of identity content

It became apparent that a participant's composition of identities activated in the working context can be used to guide understanding about its interpretation of the technology changes' threads and opportunities.

Insight into the identity content allowed further understanding as to whether or not conforming adoption will be rather fast or slow, or if individualistic behaviour is endorsed or rejected. The identity content unveils by description of what makes individuals feel in balance or out of balance, what causes stress, anxiety and what does not. If one compares these stabilising and destabilising factors with the change potential inherent in a new technology, one is able to reveal the meaning understood by the individual. Guided by these stabilising and destabilising factors, a typology of identity content emerged, that is surprisingly closely related to Schein's (1996) career anchors, however, some significant differences developed. The emergent categories of work-identities and their difference to Schein's career anchors will be discussed in detail in the following paragraphs.

10.5.1 Identity rooted in technical competence

Most commonly found among the design engineers and technicians of this research was the central identification with technical competence. Almost all participants derived a sense of self-integrity by being technically competent and by exercising this competence. One can refer to this identity as a 'typical' professional identity of design engineers. The common motivational pattern found for participants who share this identity was the perception that new technology can enhance technical competence, and can increase the problem solving capacity and individual marketability. This stabilises and increases status and position. However, this opportunity comes at the cost of temporarily challenging one's technical competence, and maybe one's position in the team. Furthermore, increasing one's competence through new technology takes time to master the new technology in the short term, and design quality is sacrificed. In short, new technology offers an opportunity for increased competence, but at the same time, it threatens this competence.

10.5.2 Identity rooted in managerial competence

An identity of managerial competence was found to be very similar to technological competence. This professional identity develops for those designers who enjoy a more senior, coordinative and responsible function. The difference in the technology counterpart is that managerial competence identities were less tightly related to technology and thus, the threads of new technological changes were related to having made the right choices in a selection process, or getting the

new technology well integrated into the work process. As with technical competence, there are opportunities and threats that reside in a new technology.

10.5.3 Identity rooted in technical or managerial challenge

Individuals who accepted a new technology early were unified by the need, maybe better described as 'their drive', to meet new, extraordinary challenges. Schein (1996) has described these individuals; however, the grounded data of this research suggests a split in Schein's original "challenge" category into technical and managerial challenge, since they emerged as distinctly different and not overlapping.

Individuals with an identity of technological challenge should be further split into two significantly different groups that have a clear impact on technology behaviour: Some treat new technology as a means of getting ahead of others; consequently, they were willing to adopt a new technology at an early stage. They also used technology as an instrument to test proficiency, power and influence, which explained their open rejection in some cases. This type is categorized as a 'technical competitive challenge' identity. In contrast, other technical challenge identities were driven to discover and to better understand new technology, independent of its recognition, a 'technical knowledge challenge' identity. This group emerged as much more laid-back and stress-resistant, because their self-concept did not relate to the 'success' and 'failure' of the undertaking, and their perceived status and prestige was not dependent on an 'efficient and fast mastering of the technology'. Their value system was significantly different.

The need for managerial challenge seems very similar to the technological, competitive challenge identity described above. Other than their technical counterparts, they valued wide networks that they turned to for advice. Having and maintaining such a network stabilised these participants; they claimed to be excellent keepers of wide and strong networks. More details can be found in the discussion of information society's new values, which indicates that such wide networks are the information sources of the future. Consequently, managerial challenge identities increasingly hold valued positions in the stratification hierarchy of 21st century's society, a development they are well aware of, and they actively maintain in order to increase status and prestige. Given this information, the effort to master the latest information and communication becomes even more worthwhile and rewarding for them.

Reducing the perception of technological change to new technical benefits, functionality and the threads of new learning are far too narrow to grasp the meaning, that competitive challenge identities, attributed to technological change. This group's motivation affirmed their self-concept at work. In all cases, technology was used as an instrument to achieve a larger goal.

10.5.4 Identity rooted in security and stability

Almost 30% of all participating designers had a central identity that sought stability and security. They all sought routine, habit and clear guidelines, through a variety of means such as organisational hierarchy, cohesive ties at work, workflow processes, or financial security through job security. This stability is jeopardized by new, disruptive technologies, because these technologies change work processes, communication structures, and they threaten existing hierarchies and positions. All of these participants held a parallel identity of technical competence as a means to ensure their stable position in the structure. Thus, new technology destroyed routines and formal structures, threatened existing technical competence, and effected short-term design quality. All of these factors destabilized and clearly outbalanced the opportunity for additional competence. This identity type 'suffered' the most, at least in the short term, from technological change and thus, they were reluctant to adopt new technology. All participants with a safety identity held one or more parallel group-identities, and they all adopted technology within the conforming spectrum.

Various narratives offered explanations as to why particular participants became security seekers. They demonstrated the influence of experience on self-concepts and meaning systems. However, these experiences were of a complex, non-linear influence on participants' meaning systems. One example was Ni, and his need for hierarchy, which he directly associated with his upbringing in communist Poland. This experience must be contrasted to Sa, who was brought up in communist east Germany, but he found no comfort in hierarchies at all. While both individuals experienced strong hierarchies and a dominant, inflexible power structure during their youth, additionally, not directly associated experiences led to very different associations in the two participants' meaning systems.

Furthermore, a correlation between the identity of stability/security and age emerged. All participants beyond the age of 55 held a stability/security identity that has grown over the years. This verifies a shift in career anchors through the influence of age (see also Marshall and Bonner 2003, p.285). While the negative correlation between learning something completely new and age is not new (Spitzer 2002, p.280), this research reveals new aspects of the phenomena that will be discussed in a separate section in this chapter.

10.5.5 Multi-identity of work-life balance

Individuals who were proud of their variety of different non work-related identities were positioned in the conforming spectrum of the adoption curve. Participants who possessed a very balanced approach towards life and work were positioned either early or at the mean point of technology adoption. They had multiple, coexisting identities that only marginally conflicted. These 'multi-identity'-selves had a balanced self-concept which did not make destabilising experiences go away, rather, it gave them multiple perspectives to look at the situation, causing what Smith-Lovin (2003) explains as "mixed experiences" (p. 175) of stabilising and

destabilising factors rather than pure destabilisation. Participants with central, non-work related group- and role-identities were more relaxed about possible work related identity conflicts. Self-complexity studies (Smith-Lovin 2003, 2007; Thoits 2003) verify these finding, while it is in opposition to theories of the decentred, fragmented self (Welsch 1987, p.194, Keupp 1997, p.17). This research that is based in the mechatronics machine design, has shown that the complex construct of respondents' multi-identity selves can protect them from situational stress.

These 'multi-identity' can be contrasted to all participants with only one central identity active at work. All of these 'single-identity-selves' happened to be work-centred role-identities, containing some form of positive self-efficacy. They adapted very early or not at all, but in both cases performing individualistic behaviour. Figure 48 illustrates the difference.

For participants with a strong need for a balanced life-style, new technology offered something new, fun and a variation to the routine work. However, they all agreed that the extra time and effort required to master new technology is not always available in the daily work environment, thus they did experience stress when managing the time requirement. However, they tend to not care and worry too much, they stay in the mainstream and take "one step at a time" (Mr).
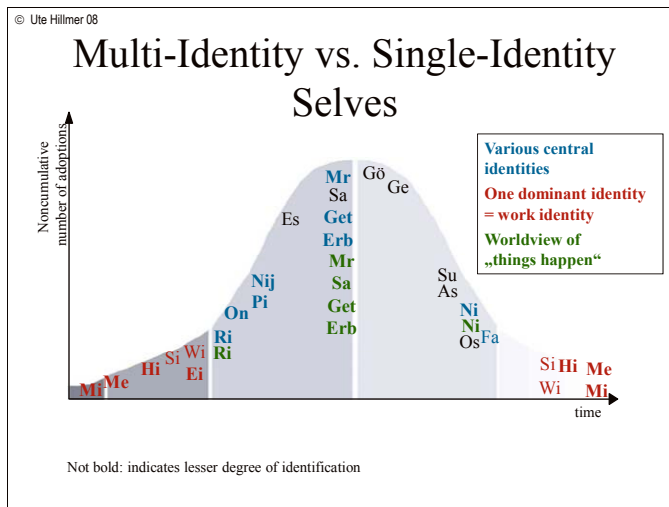
Figure 48: Multi-identity selves vs. single-identity selves at work

10.5.6 A typology of the identity content in mechatronics machine design

The previous sections demonstrated the importance of individuals' identity contents in a situation of technology acceptance. These individual contents reflect the individually different degree of societies influence on individuals' conducts, just as they show the individualistic forces through personal identity.

The investigated group of mechatronics machine designers usually held various role- and group identities along with their personal identity simultaneously. Typical constellations were an identity of technological competence along with a need for stability and security. This combination resulted in conforming technology acceptance with a tendency to late adoption. The few participants who had an identity of technological competence but no other, apparent identity usually adopted technology with the majority. Another combination found in multiple cases was the identity of technological competence together with an identity of work-life balance. These participants adopted new technology early to medium, in a conforming manner. An additional identity of technological knowledge challenge did not appear to overwrite that behaviour. Participants, where competence was dominated by technological or managerial competitive challenge adopted technology either very early or not at all.
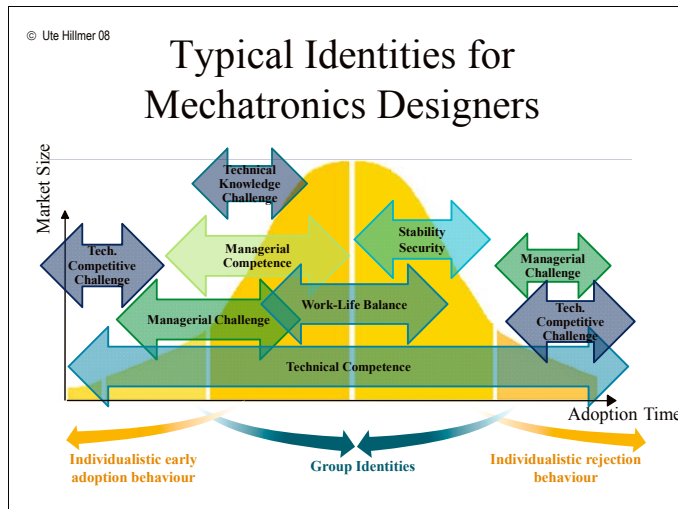

Figure 49: Typical identities for mechatronics designers

They engaged in individualistic behaviour and had a self-concept of influence and superior competence. It can be speculated that personal-identity, the more organic, pre-existing physical and psychical characteristics of an identity is responsible for the "drive" (Me) that these participants report. Furthermore, information societies value system rewards dynamic, innovation driven behaviour, which emerged as a further motivator for these participants behaviour. Figure 49 illustrates the emergent combinations of identities.

Higher importance of identities results in a higher emotional state, which includes enthusiasm or anxiety. The more emotional an individual's response is, the more

important was this identity (Stryker 1987), because there are self-integrity processes at work.

10.6 Age as a cause for identity conflicts

Older participants tend to be slower in accepting new and disruptive technologies. What has long been treated as common wisdom has been verified by neuroscience (Spitzer 2002, p.280) and this research confirms these findings. However, the meaning systems approach used in this research offers additional explanations and a deeper understanding. With increasing age, different identities are active in parallel, yet their content is not compatible, which causes identity conflicts and integrity problems. Figure 50 illustrates the age groups and their position in the adoption curve.
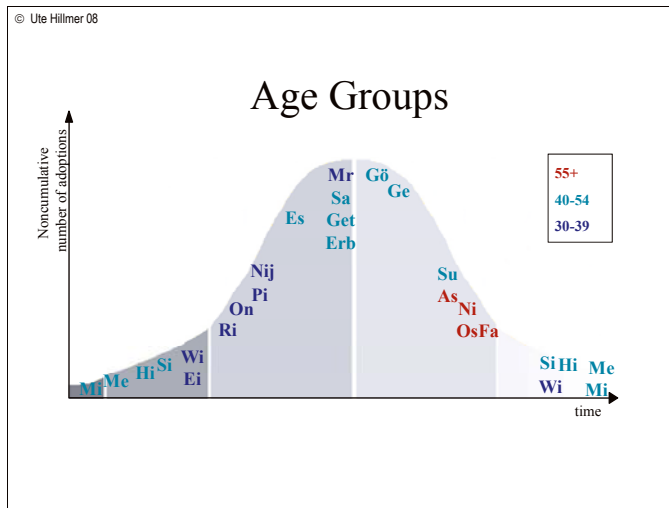

Figure 50: Age groups and technology adoption

All participants aged 55 and up mentioned significant discomfort with the impact of increasing age on their technological competence. It is the worry of not being able to keep up with technologies' pace. They all felt uncomfortable about technological change, but none fought management or team decisions. That they all conformed could be specific to the available cases, because no centrally role-based participant above the age of 55 was part of the sample. For now, only primarily conforming, group-identity based participants above 55 were considered.

Those participants have been engineers or technicians for over 30 years, and as most other participants in this research, they derived their sense of identity and integrity at work by using their technical skills. As this study has indicated, this comes along with a high identification with technology, pride in one's own

engineering work, and a joy of being challenged by technical problems. Liking and endorsing technology was an integral part of their job identity. However, being grounded in this identity requires constant updating of skills and knowledge especially in a profession that invents and designs new high-tech machines.

When these participants passed the 50s, they became increasingly aware of their age and slowly developed a role-identity as 'an older' or even 'the oldest guy in the team'. This emerging identity came with the perception and experience that learning something completely new is no longer easy; that one is slower to learn about new technology than the rest of the team because of the advancing age. Thus, reluctance and unease concerning new technology developed in this group of individuals. An identity conflict between a newly developing need for stability and routine vs. the highly valued technical competence developed. In other words, the new and growing role-identity of age stood in direct conflict with a self-concept of being a competent engineer or technician that guided their behaviour for decades. A disparity between identities developed that is experienced psychologically as the sense that the world is unpredictable, not right, or disturbing (Smith-Lovin 2003, p. 175), which makes the observed and articulated stress of this category of participants understandable.

These situations also provide evidence of the identity theory's understanding of emotions. For one, negative emotions result from not meeting one's identity expectations (Stets and Burke 2003, p.139), and when such negative emotions are felt, individuals either change what they are doing or they think of the situation in a different way in order to achieve congruency with their self-concept again (ibid. p.141). In this study, the participants could not change the aging factor, but they could change the way they make sense of the situation in order to maintain some self-esteem. Thus, the emerging data is understandable and explainable in the light of the various self-processes to maintain self-integrity (self-verification, cognitive dissonance, and self-discrepancy theory), that have been explained when identity processes were introduced in the individual section. Furthermore, Stryker (1987) pointed out, that the strength of an emotional response to identity-related behaviour signals how important an identity is in the salience hierarchy; more important identities produce stronger emotions (ibid. p. 140), which offers an explanation for the varying degree of anxiety and emotions that emerged among the individuals that considered themselves as 'older'.

Finally, one should consider the increasing societal value of knowledge in this century. As the societal perspective unfolded, information society's stratification hierarchy is increasingly influenced by theoretical knowledge and much less by practical experience. While practical experience used to be the measure of value for older employees, this no longer is true. Losing status and prestige because of a changing value system becomes particularly obvious through disruptive technological change and creates further stress.

Not all of the described behaviour can be explained by emotions and self-integrity processes only. Participants with many years of experience in machine design reported that they developed their personal ways of looking at a design problem, and they have developed personal processes that work best to resolve them. One respondent called it his "personal thought patterns" (Fa) to resolve engineering problems. They fit the individual's work and thinking style and they have been trained to become highly efficient over the years. These individually proven processes differ between participants. New disruptive technologies usually destroy such individualistic processes, because technologies commonly unify larger portions of the workflow. Consequently, participants with many years of work experience not only have to learn a new technology, they also have to "un-learn" their internalised processes. When adopting new technology, they trade what they perceive as highly efficient, for something they do not yet know, and where they expect to be slower at learning than younger colleagues.

10.7 Discussion of mechatronics disciplines

Different engineering disciplines have different educational and experiential backgrounds, which could influence technology acceptance behaviour. However, no correlation between technology adoption behaviour and different engineering disciplines emerged. A more detailed investigation of preferred data formats and working styles, which usually change with new technology, also revealed no significant relationship between engineering discipline and technology adoption.

Almost all participants reported to have worked or have been educated in at least one additional engineering discipline besides their core discipline. This thwarts a direct and specific disciplinary allocation of individuals. Future research with undisputed disciplinary allocation and a higher sample size will be better suited to reveal a possible relationship between mechatronics disciplines and technology acceptance behaviour.

10.7.1 Technology enabled work-process changes
Mechatronics related data emerged that might further increase understanding for technology acceptance behaviour particular in this industry and profession. Mechanical engineers (ME) have traditionally been the core design discipline in machine construction in Germany. With the increasing importance of electronics and sensoric technology, this hierarchy has started to shift, while organisational structures and informal hierarchies still display the traditional structure. The overall project responsibility for design and time traditionally resided in the mechanical domain. In six of the seven researched organisations, mechanically educated engineers headed the design departments. However, new market demands increase the share of electronics in machine design and new mechatronics design technology slowly changes this hierarchy of disciplines by enabling and enforcing time saving parallel design work of all disciplines. Mechanical engineers and technicians were

aware of these changes, as are some electronics engineers. The consequences are outlined by discipline in the next sections.

10.7.1.1 Mechanical engineering (ME)

New mechantronics design technology and the revised processes have consequences for mechanical engineers. These engineers are at risk to lose the project, design and time sovereignty in high-tech machine design that they traditionally owned. At the same time, they are requested to coordinate and thus understand the engineering disciplines in detail, since new technologies demand integrated, holistic understanding. Consequently, they are at the forefront of practicing mechatronics; mechanical engineers can gain most from mechatronics developments while at the same time they are at risk to lose most, too, if they fail to adjust. The mechanical engineer in high-tech machine design is offered the opportunity and the challenge to change towards an engineering generalist.

From all of the engineering disciplines, the interviewed mechanical engineers reflected the highest degree of identification with the overall project, its business indications as well as overall company and customer benefits.

10.7.1.2 Electrical and electronics engineering (EE)

Electrical and electronics engineering, along with automation and control technology, has traditionally been the "underdog" in Germany's machine design. They claimed to be involved late, when the most important design parts were frozen. Thus, the frustration of not being able to contribute creatively towards a better machine design has emerged from the data. Even more often, electrical and electronics designers complained that projects were already on a critical path, when they were handed into their department, which constantly added extra stress to their work schedule.

Among the participants researched in this study, EE engineers were very process oriented and highly embedded in the existing workflow, which can be related to their professions flow-chart dominated problem solving tradition. For EE engineers, new mechatronics design technology has different consequences: They become involved in projects earlier, and thus can actively influence machine design more often. Additionally, new machines contain increasingly more electronics and control components, augmenting the importance of their designers' contribution to overall design. Electrical engineers were the group most inflexible to accommodate workflow changes, however, once the new workflow was established, electrical engineers gained stability fast.

10.7.1.3 Software engineering

Software engineers differed most significantly from other engineering professions. In mechatronics product design, two categories of software engineers are differentiated. There are those who design the software necessary to automate and control the machine, and those who work on more sophisticated software components in higher programming languages, which usually involve the entire

product structure. While the first category merged with electrical and automation engineering functions in the cases investigated, the latter category developed components that are integrated into product lifecycle management (PLM) and enterprise resource planning (ERP). The level of complexity and abstraction of these software components is significantly higher, and these designers viewed themselves as different from the other engineering disciplines. Some of the most distinct differences that software developers pointed out were: "a piece of software is never really finished, so one should never aim to use "being done" as a measure" (Sa); It also was pointed out that one cannot study to become a software developer, because it is a hobby that turned into a job (Sa). Software engineers 'play' with solutions, rather than engaging in long upfront planning. It is a trial and error game, which one developer described as "doing, not thinking" (Pi)[9]. The work of these software designers became significantly more structured through new technology, offering modular design approaches that "take away creativity, but that allows a new level of depth" (Sa). Software developers seemed especially aware of technologies fast development and that "getting older", is destroying competence. One software designer in the early thirties wondered for how long he would be able to follow the increasing level of abstraction necessary for good software design.

10.8 Limitations and potential areas for future research

This study adopted a new perspective to understand technology acceptance behaviour. To understand the problem differently, a multi-disciplinary literature review was developed using frame analysis. In order to find out if this perspective is helpful and which aspects work and which do not, the investigation was very broad and multi-disciplinary, which limits its overall depth but no more than other work of its kind. In the final analysis, this work has provided a new, user-focused perspective in technology acceptance. Additionally, the qualitative case study approach produced specific conclusions that may be useful in other contexts.

10.8.1 Limitations of the research design
The frame analysis used a single case study to navigate through a broad spectrum of existing theoretical knowledge. Bryman (1988, p.90; cited in Saunders 1003, pp.260-1) argues that within one case study, a wide range of different individuals and activities are invariably examined, and the contrast with survey samples is not as acute as it appears at first glance.

The field research for this study was conducted in seven German mechatronics machinery organisations with twenty-two machine designers, and it can be argued that the sample is small and unrepresentative. However, the findings do not have to be limited to these cases. They do relate to latest identity theory's positions, which

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[9] There are various structured and unstructured ways to go about software development. One perspective is expressed here.

according to Bryman (1988; ibid), and Yin (1994; ibid.) supports generalisability of qualitative research and verifies the applicability of methods of social psychology to the research problem. Furthermore, in technology acceptance behaviour, the causal linkages are complex and cannot be clearly determined in this research.

The researcher works with self-reported data from participants who were roughly categorised and pre-selected by their management in order to offer a spectrum of technology acceptance behaviour. The researcher ensured confidentiality and trust was initiated between the parties, but there was no guarantee that this occurred. It is ultimately up to the participants to volunteer data, to report truthfully, and it is not possible to control bias in all cases. Furthermore, there may be a misinterpretation of responses. Overall, in-depth interviews offer the opportunity to establish trust, and to explore meanings and intents; thus, they allow a summary of understanding by the interviewer. Never the less, the researcher was not able to understand one of the twenty-two participants (Get).

10.8.2 Unsatisfying research approaches

10.8.2.1 Company culture, group-identity and technology acceptance behaviour

The study was designed to distinguish between different organisational cultures regarding technology acceptance behaviour. However, this research unveiled that different participants perceived the same organisation or work-team very differently, which affirms a meaning system approach. Furthermore, the perceived culture did not emerge in any correlation to individual's technology acceptance behaviour. Quan-Haase et al. (2007) indicate evidence that in the perception of most individuals, the organisation remains a hierarchy, independent from its organisational structure, which might explain these results.

Some research indicated a negative correlation between the downsizing experience and participants' degree of identification with their company (Marshall and Bonner 2003). This research does not confirm this finding; but supports the opposite, which might be specific to the industry segment or to the national culture. All participants who were on the job for more than 10 years have observed or experienced significant restructuring and downsizing efforts within their company and departments, yet their company loyalty and identification within the organisational structure remained strong.

10.8.2.2 Preferred working styles and data structures

The attempt to investigate preferred working styles, data formats and their relation to technology and technology adoption did not reveal any pattern. In order to yield better results, a much more focused research approach might promises more success. This research design was targeted at understanding individuals' meaning systems through a loosely knit web of questions that probed the individual thoughts, but did not produce the extraneous understandings of preferred data formats.

10.8.2.3 Twenty statements test

Kuhn and McPartland's "Twenty Statements Test" was utilized and analysed in two directions. The number of answers related to a working context in comparison with other contexts (e.g. family) was intended to reflect an individual's embeddedness at work. The specific individual patterns were compared to other available identity and embeddedness data and to technology acceptance behaviour. The responses did not correlate with any of the other research findings. This can be attributed to a mistake in research logistics: While all other information was contributed in a working environment, which is said to activate the 'relevant work identities', the twenty statements test was often filled out in a private setting at home. According to identity theory, this different environment activates different identities that are not necessarily in any relationship to the research.

10.8.2.4 'If…then…' self encoding

Furthermore, the 'if … then' self-encoding approach to conceptualise personal structures did not yield useful data in this research design. The three questions in the format of "if … then I would reject a new technology for product design completely" did not fit the otherwise conversational flow of the investigation, and consequently, both the researcher and most respondents felt uncomfortable. The data that emerged seemed completely out of context in the sense that it was unrelated to the immediate working context and rather hypothetical. An example is the answer "if it were military arms of offence technology, then I would reject… " from a respondent who actually rejected a new design technology within his working context without any military relation. However, the generic answer 'I would reject' requires a conscious motivation, which is most likely not present in the typical rejection process at work. Consequently, 'if … then…' questions were removed from the semi-structured interview guide after ten interviews.

10.8.3 Recommendations for future research

This study is considered action research, and it was based on the premise of understanding the domains involved in order to successfully investigate technology acceptance holistically. It was not clear in the beginning, which direction the study would take, and which areas of existing knowledge would contribute. This study has been an important first step toward uncovering relevant additional perspectives to further understand technology acceptance behaviour. Further, detailed research is necessary in order to understand the in-depth, causal relationship between social identities and personal identity and their influence on technology acceptance behaviour. This might be achieved through the detailed investigation of specific acceptance behaviour and its relationship to identities, by the investigation of 'multi-identity selves' vs. 'single-identity selves', or by investigations in and across industries and professions. All of these future research areas can contribute to a broader theory of technology acceptance behaviour. While this methodological approach is likely to produce different results in different industry segments and

with different professions, the applied methodology is not industry specific and might be therefore of general interest.

10.8.4 Validity vs. inherent bias in this research

From a position of symbolic interactionism, no objective truth and meaning is possible; there is always some interest encoded and a particular world-view applied in any research design. According to Johnson and Duberley (2000, p.170), the adjudication of the truthfulness of any knowledge-claim can only occur when there is a clear reference to the interest that started the investigation or the statement in the first place. In other words, in order to ensure validity, the researcher's interests and world-views must be openly stated, which has been discussed at the outset. Being aware of possible bias, preparing the research details precisely, and being reflexively aware of one's own bias were precautions taken in this research.

The "pro-innovation bias", which dominates the thinking of the western business world, must also be considered when discussing bias inherent in this study. The "pro-innovation-bias" reflects that new technology is generally viewed as progress, which is something organisations usually want, and consequently, innovativeness is laden with positive value (Rogers 1995, p.104). This bias is present in this study, however to diminish this bias, the behaviour was documented and discussed value-free. Throughout the research, participants behaviour, rather than personal characteristics are discussed. The pro-innovation bias is relevant, because history reveals cases where the assessment that innovation equals progress is wrong: many drug related innovations were highly consequential in a negative way; nuclear power has revealed many negative sides; thus, it is questionable if recent innovations ought to be seen in a positive light only. Maybe the real heroes of technological changes are those that resist technology. The pro-innovation bias is a cultural bias and cannot be disowned in this study.

10.9 Implications relating to theory

This research study explored a meaning system approach to technology acceptance behaviour. The influence of an individual's subjective meaning in a situation of technological change was researched. Furthermore, social and individual sources that wield influence on this subjective meaning primarily using identity theory and network theory were researched. Contradicting and thus conflicting situations were brought to light by neural network models, self-integrity theory and mechanisms to protect the self-concept.

This alternative approach revealed meaningful, new insight into technology acceptance behaviour, and this contributes to the spectrum of existing knowledge on technology adoption by closing a gap between social structures, an individual's meaning and self-concept, and influence on behaviour; aspects that have not been investigated to date.

10.9.1 Contribution to technology acceptance and adoption theory
This research study focused on meaning, as individuals attach it to technological change. In so doing, the study focused on the immediate and past context, and on social and individual influences that might be scarcely perceptible. None of the existing technology acceptance models takes into account such elements. However, these elements are considered highly influential when evaluating individuals' behaviour from a perspective of symbolic interactionism. Existing models of technology acceptance and adoption can benefit from additional studies of individuals' meaning systems, as suggested in this research study. Rogers' theory of technology diffusion, in particular his technology adoption model, assumes a personality difference among the various different adopter types, but it does not go further. This study contributes to this theory by offering further levels of details in understanding and a methodology to go about it. The focus in this study was on twenty-two cases in mechatronics machine design. Future research within different industry sectors and professional groups may be necessary to broaden the spectrum.

Contribution to management science
This research study used grounded theory to study a business problem, which is not common practice. The results encourage the use of this theory, which promises the consideration of a more realistic spectrum of influences towards behaviour at work. The particular findings of this research study qualify aspects of an individual's meaning system as important, the role of self-integrity in a situation of technological change as highly influential, and the suggested identity typology for mechatronics design professionals as a guiding structure. All three aspects have implications for theory in change management, technology development, technology diffusion theory, technology marketing as well as technology sales. Each one of these knowledge domains is enhanced by sharpening consciousness and understanding for technology users' spectrum of identities and the derivable factors that influence self-integrity. The grounded theory approach has shown that social psychology literature has a part to play in a deeper understanding thus provides business science with an additional valid and alternative way of investigating business problems.

Contribution to organisational psychology
This research study also contributes to organisational psychology by confirming Schein's (2006) career anchor theory, described in the organisational perspective of the frame analysis. This research identifies different and more specific anchors found in the mechatronics niche, which might offer an explanation as to the ongoing dispute between the appropriateness and inappropriateness of his selected anchors. They may be specific to the industries or professions investigated. Furthermore, this research validates that career anchors change (Bonner 1997; cited in Yarnall; Feldman and Bolino 1996; Igbara et al., 1999), and that more than one career anchor can be active at one time (Feldman and Bolino 1996).

Contribution to social psychology

The research study results verify symbolic interactionistm based identity theory. This study applied typical methods, attaining identity theory, and the area of multi-identity and its effects of intensification or collision of values, beliefs etc. emerged as particularly interesting for technology adoption behaviour. Furthermore, the research reveals some limitations in Dweck's (2000) theory on learning styles. Dweck's theory served as a guide for further insight into learning styles, however, her clear cut two categories of learners, a master learner vs. a helpless learner are derived from students and did emerge as too limited in the business world of mechatronics machine design. More context specific mixtures of the two categories were found that reflected the various identities and interests that participants held in parallel.

10.10 Implications relating to practise

This research study also has implications for the practice of technology development, technology diffusion, technological change management as well as technology sales and marketing.

Unpredictable and confusing technology acceptance behaviour is stressful for all involved parties. Users experience stress and anxiety whenever technology is perceived as a threat to their self-concept and -integrity, and those strong feelings and emotions can get in the way of good work. Since organisations only attain an anticipated effect, if users make full use of technology, it is in both sides best interest to reduce anxiety and increase understanding. Along the same line of reasoning, technology vendors invest time, money and effort in new technology development, yet their technology inventions dye early, if they do not diffuse.

This research study further suggests that technology acceptance behaviour can be grasped and assessed prior to technology adoption, when one sharpens one's attention and develops sensitivity to an individual's embedment in the organisational structure and to its active identities. When aiming to implement a new technology successfully, one must gain an understanding of the individuals and their degree of embeddedness in the organisation. This may help to determine if a particular individual should be confronted with new technology in an initial kick-off phase, where the technology adoption is an individualistic act, or rather later with the majority of the work-team. Role-identity centric individuals that hold no group identity are willing to 'stick-it-out' by making an early move towards a new technology, if one is able to make the new technology contribute to these individual's personal goals. However, these goals are highly individual, often well hidden and not easily revealed, yet once they are understood, technology vendors can enter the market at an early stage and pilot projects can be implemented successfully. In contrast, individuals who are well embedded in a group, meaning they hold one or more central, work related group-identities will conform to the

overall decision but will aim to move with the majority of the team, which makes them unsuitable for the kick-off phase of a new technology.

When the goal is to develop a successful, broadly applicable new technology, or technological process, the conforming group-identity centric user is an important source of information. Their work-centric common identity combinations offers valuable guidance to 'must-have' features of the technology, and to add-ons that will increase the comfort level of adoption and usage for this majority group.
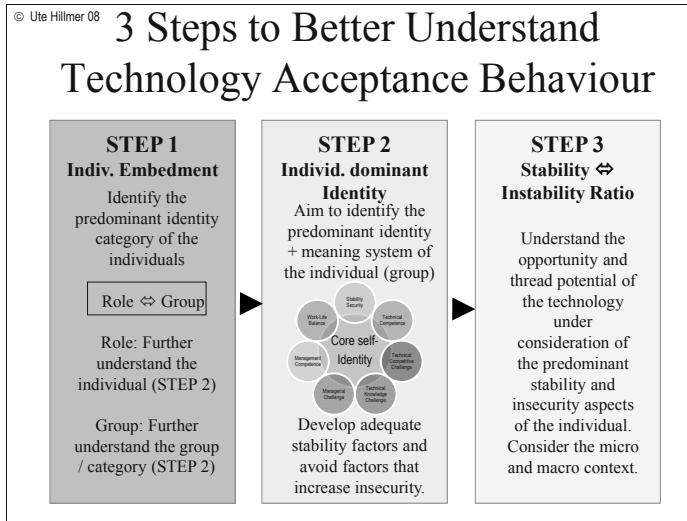

Figure 51: Three steps to better understand technology acceptance behaviour

Overall, being sensitive to the various parallel identities of group-related individuals is crucial for development teams that define the core features of a new technology. There is some value for the project manager in charge of implementing a new technology, in order to identify the appropriate users for the various phases of a technology roll-out. Understanding and addressing the particular needs of the various identities, for machine designers, especially those with an stability and security identities is likely to ensure a smooth and anxiety free roll-out. Finally, this conforming group is the target user group for any marketing and sales activity beyond one-to-one marketing and sales, which is applicable once a technology has been introduced into a market.

However, in order to initially kickoff a new disruptive technology, this conforming group is not critical. For a technology vendor to launch a new technology into a market, for a change manager to get a change project started, role-identity centric individuals must be understood in their overall drive to compete and in their individually different personal goals. Since the goals vary, sales and marketing

activities have to be highly individualistic, which is reflected in some technology marketing strategies such as one-to-one marketing (Pepper 1993). Figure 51 illustrates the overall logic of this new process of understanding.

This research study also may indicate that the assessment of an individuals' interpretation of technological change is situation and context specific and cannot be generalised. However, a typology of identity types for mechatronics machine designers emerged that is summarised in Table 10. Such a typology aids a fast assessment of identity types and their meaning. It is highly feasible that within other industries and professions, other typologies are found. Finally, if technology vendors understand the identity topology of the mechatronics machine designer, they can design products that cater of the most relevant aspects of these identities, making technology adoption more likely in the first place.

Next page: Table 9: Typology of identity types for mechatronics machine designers

Table 9	Technical Competence Identity	Managerial Competence Identity	Security/ Stability Identity	Technical /Managerial Competitive Challenge Identity	Technical Knowledge Challenge Identity	Work-Life Balance Identity
Self-concept Driving motivation	*I am technical competent. I can learn what I don't know.* Liking of technology and its functions; doing a good job for the company; some: specialised are of knowledge.	*I can manage this. I can learn what I don't know.* Rest similar to technical competence	*I have made it – and I secure it now.* Aim for employment security, work routine security, financial security and geographic security.	*I can do it, no matter how hard it is* A need to meet new, extraordinary challenges and successfully resolve it; feeling technical / managerial superiority to the rest of the team; pleasure of competing and winning.	*I want to explore this* Meeting a new technological challenge; further understanding technology; playing with technology and discovering if it is useful.	*Life is more than work* Multi-identity individuals; There is more that work to life. One must enjoy the way, not the goal, else life is over and one had to time to enjoy it.
Characteristics	High technical skills; high identification with technology, pride in one's engineering work and a joy of being technically challenged. A professional identity for machine designers.	Analytical, financial and interpersonal skills. Motivated to exist in a political environment. Emotional make-up to make highly consequential decisions with only partial information. A professional identity for senior, managerial machine designers.	Security factors would not be compromised; to 'function well' ensures tenure in a job.	Doing what nobody succeeded to do or tried before; competing and winning. Highly competitive; perfectionist; dynamic; innovative; impatient; more clever.	Discover something new, understanding something further; high curiosity.	Career as a part of a larger "life system", family and private concerns integrated into the career plans in order to achieve a valued life style. Tend to not care and worry too much; aim for going one step at a time; perceive the world as something that can only partially be influenced.
Stability factors	Competence and knowledge; a sense of being able to cope with work challenges; ability to learn; being respected for work; being efficient as well as willing and capable to work hard	Holding a network of experts; rest as technical competence identity	Save job; competence; to function well; be a loyal member of a valued group to receive loyalty back; doing 'good work for good money'; having a stable position within the working hierarchy or workflow; clear, stable structures; for some: cohesive ties at work.	Feeling respected by others; meet + master challenges, and be recognised for it. Doing something valuable, something "good for humankind; affirm self-concept to themselves and to the world. Mgmt: having and maintaining wide networks of expertise.	Learning something new; understanding something better; having time to enjoy a discovery job; having food for thought.	Various parallel identities give them multiple perspectives for a situation; not taking work too seriously, because there are other important things; being part of a larger system➔ relaxed attitude towards their influence in the world
Destabilizing factors	Questioning technical competence and knowledge by them or by others; complexity of the technology that must be designed can be overwhelming ➔ the feeling of lacking professional competence; not enough time to do a quality job	Questioning technical competence and knowledge by them or by others; Uncertainty and complexity of decisions ➔ the feeling of lacking professional competence;	Questioning job security; questioning technical competence and knowledge by others ➔ endangers tenure in a job, changing hierarchies and workflows;	Not gaining recognition for achievements; not being respected as superior; not being able to cope with a situation;	Not having enough time to 'enjoy' new discovery.	Having to compromise time between different valued groups; feeling of disloyalty towards others when there is no time for them.
Like about new techn.	Opportunity to enhancing technical competence; enhancing problem solving capacity; enhancing one's marketability; opportunity to enhance status + position.	Opportunity to enhance managerial competence; enhancing problem solving capacity; enhancing one's marketability; opportunity to enhance status + position.	Can further ensure job security; can make work easier and helps to do the job, once routine is established again.	Opportunity to get ahead with new technology; achieving personal career goals; new challenge and competition; gaining status; learn something new.	Something new to discover and 'play with'.	New technology offered something new to learn, fun and a variation to routine work.

11. Conclusions

The central aim of this research study is to develop a greater understanding of the relationship between social and/or personal influence and technology acceptance behaviour. The study attempted to increase understanding about the ways in which social and personal influences affect an individual's subjective interpretation of a situation of technological change in the working context. This was achieved by increasing an understanding of the subjective meaning, users attain in a situation of technological change.

The frame analysis used in part III discovered a multi- and cross-dimensional context, which focuses on the individual and that is not considered in the technology acceptance models available today. This new consciousness has been achieved by merging accepted knowledge from organisational, individual and societal perspectives. This holistic approach led to the conclusion that individuals' subjective interpretation of a situation of technological change, in combination with their individually different composition of self-integrity, is a significant indicators for technology acceptance behaviour. This new perspective takes into account individually different cognitive-affective meaning systems that hold various group- and role-identities, which guide and limit behaviour in socially recognised categories, but are also influenced by an individual's personal identity. These three identity types may operate simultaneously in one situation to influence behaviour. When studied together, they show how individuals are constrained by social identities' normative or structural frames but how they also have some choice in their enactment through personal identity. Depending on the situation and on the individual, some identities become central in a hierarchy of identities and others are not present. The unique combination and salience of social- and personal-identities determine the degree of role- or group-compliant behaviour. Altogether, a cross-disciplinary model emerged that explains the hard to understand invariance of personality combined with the variability of technology acceptance behaviour across situations. In addition to the overall cross-disciplinary conceptionalisation of a cognitive-affective meaning system, individual perspectives (Part III, Chapter 5) have shown that unpredictable and confusing behaviour may result in a struggle between the sometimes opposite forces of various parallel identities. Behaviour may be very consistent and assured when it is based on correlating values of parallel-activated group-, role- and personal-identity, tying all three levels of identification into one, coherent action. On the contrary, when meanings and expectations associated with a social-identity conflict with the meanings of personal-identity, or when social-identities conflict with each other, individuals may ignore role- or group-identity to maintain personal-identity or the other way around. This behaviour may be understood as a balancing act to retain some form of self-integrity, because individuals tend to behave in coherence with their self-concepts and identity schemes. When dissonance occurs, the individual may

consciously or subconsciously act in order to protect his or her self and self-concept. These self-integrity processes are sources for behaviour that seem unpredictable and confusing for an unaware observer. The analysis further highlights identity theory as a possible approach to make these hidden self-processes identifiable.

The impact of society and social reality on self-concepts and identity schemes appear to be unveiled in societal perspectives (Part III, Chapter 6). Technological change as a source for social change and a source for imbalance is another consideration from the societal chapter. Furthermore, the 20th and 21st centuries were identified as centuries of increasing personal choices for acceptable self-concepts and identity schemes, at the cost of loss of a clear cultural and moral guidance for behaviour. The loss of one uniform social reality and meaning leaves it up to the individual to find a coherent sense of self out of a range of options. The organisational perspective (Part III, Chapter 7) offers additional, selected organisational structures that offer formations for identity generation, such as professions, disciplines, organisational cultures and career anchors. They may all contribute to an individual's overall self-concept. Part III, Chapter 8, concluded that perhaps many technologically mediated changes of the 21st century affect the individual's sense of self-integrity, with a direct impact on feelings of stability or instability. It is this spectrum of change, the individual interpretation of this change and its consequences on well-being that emerged as the new centre of this research studies research problem, thus it became an area of attention for further, empirical investigations.

Overall, a consciousness emerged that understanding an individual's active identities and these identities' hierarchical order in a situation of technological change may be a key to gaining insight in the social and individualistic forces that contribute to behaviour in disruptive technology acceptance in the mechatronics machine design.

Studying a sample of twenty-two mechatronics machine design engineers and technicians (Part IV, Chapter 9, 10), this study discovered a technology adoption typology for mechatronics machine designers. Only participants who did not hold central group identification in the organisational working context actively pushed or rejected a technology and engaged in individualistic behaviour, independent from organisationally 'correct' behaviour. All participants who held a central work related group-identity engaged in conforming technology acceptance behaviour, which means they eventually accepted group or management decisions. Furthermore, conflicting group- and role-identities activated in parallel offer insight into contradicting forces that might lead to inconsistent behaviour. Finally, and in contrast to existing explanations, participants that actively pushed a new technology were the same individuals that take the freedom to actively reject a new technology.

In order to determine more precisely at what point in time an individual will adopt a technology within the individualistic or conforming spectrum, the individual's central identities offer deep insights, because they are tightly related to an individual's self-concept and feelings of self-integrity.

Within the industry sector of mechatronics machinery construction and the profession of designers, seven not mutually exclusive, work related identity-content groups emerged.

- Technical competence identity
- Managerial competence identity
- Technical competitive challenge identity
- Managerial competitive challenge identity
- Technical knowledge challenge identity
- Work-life balance identity
- Security and safety identity

Depending on the individually unique combination of dominant identities and the degree of complementing or competing content, one may be able to differentiate those individuals who adopt early within the conforming spectrum, those who adopt at the mean of overall adoption, and those who are reluctant to adopt, but who will finally give in to the adoption decision. Furthermore, this typology may indicate when individualistic behaving individuals will endorse and when they will reject a technology.

All participants held an identity of technical competence, a professional identity of the participants. New technology may enhance this identity, but comprises the risk to lose competence, status and prestige in the short term. This identity was combined with other identities. Individuals, who had a central identity of technical or managerial competitive challenge adopted technology prior to all others or not at all. They were competitively driven by a personal goal and new technology was judged by its ability to support this goal. A slightly different group were technically challenge identities, who were not driven by competition but by curiosity. They were eager to learn about something new, but this drive was balanced by other parallel identities. Thus, these individuals adopted early to medium in a mainstream, conforming fashion. In contrast, individuals who were driven by a need for security and stability were reluctant to adopt new technology, however, their parallel identities, e.g. that of technical competence mediated the reluctance to a varying degree. They adopted between an average and very late time-frame within the conforming spectrum. Finally, individuals who hold an identity of work-life balance were complex multi-identity individuals that were found to be rather stress-prone at work. They adapted in early to medium time–frames within the conforming spectrum, and did not take technology or themselves too serious. Overall, when multiple identities were active in parallel, they functioned as a vector addition as stated by Stets and Burke (2003, p.24), which explains the broad variety of resulting behaviour in a situation of seemingly identical external factors.

This study added a significant new dimension to technology acceptance research. It demonstrated the importance of an individual's subjective interpretation of a situation of technological change. This information acknowledges the existence of subconscious action and the influence of society and 'common knowledge' on what appeared to be a free will.

The new understanding of technology acceptance behaviour and identity theory application leads to recommendations for theory and practice. Existing theoretical knowledge in technology acceptance theory can gain further depth from paying attention to individuals' subjective meaning, attained to a technology. The interpretation of a situation of technological change can be accessed and understood by applying the latest knowledge from a 'meaning system approach' based identity theory. This additional perspective offers access to cognitive, emotional, self-concept and self-esteem related aspects of individual behaviour that all mirror the unique, individual mixture of social, organisational and individual influences that are part of individuals' complex working reality.

Recommendations for practice are rich and cover technology vendors as well as technology implementing companies and their change managers. These recommendations follow the technology adoption concepts of Rogers (1995) and Moore (1999) that have been discussed among the existing models, and takes them further. Whether one develops new technology for a particular market, or one wants to modify an existing work process with a new technology, in both cases one should seek to understand the work related identities of the targeted groups of users.

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Appendix

A1. Determination of Meanings

Behaviour
"Behaviour consists of patterns in time" (Eibl-Eibsfeldt 1970; cited in Kolb and Whishaw 2001, p.6) and these patterns can be made up of movements, vocalisations, changes in appearance, or even thinking. Less abstract, behaviour is any kind of movement in a living organism that has both a cause and a function; behaviour varies in its complexity and the degree to which it depends on learning (ibid. p.7).

Capitalism
Capitalism describes a system of commodity production involving competitive product markets, the co-modification of labour, power, and the production for the sake of profit and its private appropriation as the dominant economic rules (Drucker 1969; cited in Steinbicker 2001, p.24).

Collective identity
See social identity.

Compliance
Compliance is the altering intention in response to pressure.

Culture
Cultures are our historically produced systems of beliefs and codes (Castells 1996, p.328). It usually becomes "the way of life for an entire society", and includes codes of manners, dress, language, religion, rituals, norms of behaviour and systems of belief (Jary, and Jary 1991).

Disruptive technologies, discontinuous technologies
Disruptive technologies, sometimes also called discontinuous technologies are technologies that introduce completely different attributes from what was valued before (1997, p.114). These new attributes require the end user and the marketplace to dramatically change past behaviour (Moore 1995, p.13).

Embeddedness
Embeddedness or embedment is a perspective increasingly used in management science and it refers to the fact that behaviour is shaped by the social relations surrounding the individual or group and by the norms and values associated with them (Marx 2004, p.56).

Group

A group is any collection of people who share a common identity as a group, who "perceive themselves to be a group" (Handy 1999, p.150).

Group-identity

Group-identity is a social-identity that represents the norms, values, beliefs, goals, morality and practices of a group or collective. Having a particular group-identity means to be at one with a certain group or category, being like others in that group and seeing things from the group's perspective; a uniformity of perception and thus a uniformity of action among the category.

Identity

Identity in this research study is the self-concept in a particular situation. It is the intrinsic knowledge who one is (Mead 1934, p.174). Self-processes create identities in order to mediate between the individual and the actual situation (e.g. Epstein 1976, p.16; Haußer 1995, pp.7-8; Keupp et al., 1999, p.28; Stryker 1980, p.60). Identities are sources of meaning for particular life situations (Castells 2004, p.6) and they provide standards of what one should do or be (Higgins 1987; cited in Leary and Tangney 2003, p.9), however, they also reflect parts of the unique individual.

From the perspective of neural network models, identities are mental-emotional representations (the meaning system), which includes processes involved in individuals experience of themselves, their perceptions, thoughts and feelings about themselves, and their deliberate efforts to regulate own behaviour (Leary and Tangney 2003, pp.6-8), the result of these ongoing processes is an individual's salient identity. Such an identity is 'a product of the self', but also highly dependable on the immediate environment, and how the individual construes this environment, which again depends on her or his meaning system. The self is organised into multiple parts, and those parts are an individual's multiple identities (ibid.).

This definition automatically implies that identity is never final nor settled, social interactions ensure its ongoing modification. As McAdams (1993) puts it: "identity is a life story" (p. 5) and an individual begins working on it in late adolescence and young adulthood in order to provide unity, purpose and meaning to life. Lastly, identity must be understood in relation to something else (Haußer 1995, p.4), identity in relation to a group, a community, a society or another individual.

Social-identity

A group- or role-identity.

Role-identity

Role-identity in this study is believed to be a reaction to those who are different, conditioned by the existence of these others and the overall social structure. In this

function, role-identity is often related to group-identity: a relationship with the group that is recognized as different (Abdelal et al. 2001, p.8). In this definition, role-identity can but does not necessarily have to refer to the labels applied to people in a particular situation, who are expected or obligated to perform some sets of actions, routines or functions (Fearon 1999, p. 17).

Personal-identity
Personal-identity is inherently personal, pre-existing organic in a physical and psychological sense (Thoits 2003, p.181). It is also referred to as "person identity" (Stets and Burke 2000, p.16). This identity derives from what Mead called the "individual self", the "I" (1934, p.214) and is said to describe 'who one truly is'; the undetermined unique human thought and behaviour that attributes to individuals' free will, spontaneity and creativity; all the elements that attribute to "personal agency" (Thoits 2003, p.181).

Self-identity
An individual's self-identity is defines as the sum of all identities within a particular situation for one individual. This definition is close to Gidden's (1991, p. 42-59) use of self-identity.

Information
While information is a broad term, the definition relevant for this work is more precisely "knowledge–based information" that consists of codified, formal knowledge that can be applied in the pursuit of a concrete goal. In this sense, it is information about how to organize progresses, and it is this form of information that has become the differentiating factor in the information economy (Stalder, p.71).

Information technology
The converging set of technologies in micro-electronics, computing (machines and software), telecommunications/broadcasting, and opto-electronics (Saxby 1990; Mulgan 1991; cited in Castells 2000, p.29)

Institutionalisation
Institutionalisation is the transition from Weber's (1947, p.115) goal-rational behaviour, to value-rational behaviour, where meaning is in the action and no longer in the goal. In a corporate context, individuals who work within large established organisations can become socialised into organisational values and norms, and values and norms may become institutionalized.

Institutions
"Organisations vested with the necessary authority to perform some specific tasks on behalf of society as a whole:" (Castells 2000a, p.164).

Internalisation
The process of internalisation is to embody explicit knowledge into tacit knowledge (Johnson and Scholes 2002, p.181).

Meaning system
Individuals have a system of beliefs that they create meanings from. This system of beliefs can be called a 'meaning system'.

A meaning system construes the world and can be stated in terms of a highly organized, coherent system of mental-emotional representations (Mischel and Morf 2003, pp.16, 23). This 'translation program' or 'filter' makes sense of the world, it is essential to the self and for the creation of a subjective reality based on individual beliefs, values, goals, needs, and ethics. One can say the meaning system or mind is occupied with the meaning of things; the organized response answers to the stimuli (Mead 1934, p.131).

Mechatronics
"Mechatronics stands for the integration of the disciplines of mechanical engineering with mechanics, precision technology and drive technology, electrical engineering with performance and microelectronics, and information technology with automation and software technology" (VDMA 2003, p.2).

Mechatronics machinery industry
The branch of industry that engages in mechatronics machine development and building.

Mind
See 'meaning system'.

Modernity
This study uses the term modernity following Giddens (1991) as a general decryption of the period of post-feudal Europe, or in a more global perspective it can be understood as roughly equivalent with "the industrialised world" (ibid., p.15).

Networks as a pattern of organisation
A network organisation is defined simultaneously by its nodes and the relationship among them (Urry; cited in Stalder 2006, p.177). Notes create and define one another. The process of inter-definition is bi-directional and there is no hierarchy. This pattern of interaction in a network is much more flexible than a hierarchical structure, were the whole defines the part. In contrast to a market organisation, that is defined as the aggregation of individual actions that define the whole, a network structure is much more enduring. Networks are characterised by the continuous inter-definition of network participants (Stalder 2006, pp. 177-8). It is a mutual adjustment between its elements. Importantly, this transformations are not random, or entirely open, but determined by the overall pattern of interaction, by the

networks own internal logic (Musso; cited in Stalder 2006, p.178), its network code. Castells network society is an informational network. An enduring pattern of large-scale interaction among heterogeneous social actors coordinating themselves through electronic information flows. These networks combine flexibility and coordination (Stalder 2006, p.187).

Personal Identity
See identity.

Power
Power in classical Weberian terms, is "the possibility of imposing one's will upon the behaviour of other persons" (Weber 1954, p.323; cited in Stalder 2006, p.104).

Role-identity
See identity.

Self, self-processes
From a classical sociological perspective, the self is a relatively stable set of perceptions of who we are in relation to ourselves, to others, and to social systems. The self is organized around self-concepts, the ideas and feelings that we have about us in different situations. In this study, the self is the sum of all attention, cognitive-emotional and executive self-processes. As such it comprises self-concepts, self-awareness, self-control, and self-integrity. Self-processes are sens-making and identity-generating processes.

Self-concept
The self-concept is the intrinsic knowledge about who one is. It is 'the book that holds the thoughts and beliefs about oneself', the 'me' (Mead 1934, p.174). In other words, it contains the sum of judgements or the various partial judgements of an individual about itself (Epstein 1979b; cited in Fischer and Wiswede 2002, p.355).

Self-esteem
can be used as a measure how well an individual can accept itself, how it values its contribution to its environment, and how it judges its self-efficacy (Fischer and Wiswede 2002, p.356).

Self-integrity
This research uses self-integrity to describe the matter of individuals integrating various parts of their self into a harmonious, intact whole. Understood in this way, integrity is primarily a matter of keeping the self intact and uncorrupted.

Self-process
See self.

Social-Identity
See identity.

Social networks
A set of nodes (persons, units, organisations) linked by a set of social relationships (friendship, transfer of funds, overlapping membership) of a specific type (Laumann, Galaskiewicz and Marsden 1978, p.458; cited in Marx 2004, p.71).

Social reality
Social realities are the perceived truth of social groups or whole societies. When individuals have internalised certain social values, standards, norms and roles, one speaks of their social reality. Social reality becomes one's consciousness and offence against these inner norms results in a form of guilt (Fischer and Wiswede, p.64).

Society
When society is used independent of a particular authors perspective, Giddens' (1989) definition applies, which defines society as a "system of interrelationships which connects individuals together" and were members are organized by a structured social relationship, following a unique system of values and norms (pp. 22-3). This definition particularly contrasts society from 'nation' or 'state'. A nation or a state can form a society, but this is not mandatory.

Solidarity
Solidarity gets defined in this work along with Durkheim (1992, p.48; cited in Misztal 1993, p.209) as the commitment, which subordinates individual interest to a larger social whole.

Subjective reality
Identities proactively construct an individual's subjective reality (Cantor et al., Emmons 1989, 1991; Mischel et al., 1996; Pervin 1989; Zirkel and Cantor 1990; all cited in Mischel and Morf 2003, p.30). It is accessible only to a particular individual, and take place only in this individual's inner life. Furthermore it must be stated in relation to the situation in which it takes place and in relation to the individual interpretation of it.

Subjective reality can be interpreted as reversal through an individual's identities, its goals, values, self-evaluation, motivations, and self-regulations, and its self-theories that are expressed. It can become obvious in the selection of life tasks, and projects pursued.

Technology
Harvey Brooks (1971, p.13) and Daniel Bell (1976, p.29) (both cited in Castells 2000) definition of technology is "the use of scientific knowledge to specify ways of doing things in a reproducible manner." (p.28). see also 'disruptive technologies'.

Technology acceptance behaviour

Technology acceptance behaviour is a spectrum of behaviour that must be seen in contrast to technology adoption. It is the range of behaviour individuals engage in, when they are confronted with a new, disruptive technology. It ranges from enthusiastic technology endorsement, various degrees of adoption from fast and open to reluctant and hesitant, to hidden or open resistance.

Technology adoption

Technology adoption is the decision to make full use of an innovation. (Rogers 1995, p.21)

Values

Values are core beliefs or desires that guide or motivate attitudes and actions (Oslander et al. 1995, p.102).

A2. Interview Guide (translated English version)

Company: Name: Date:

1 EXTERNAL REALITY:

1.1 Behaviour towards technology: likes

What do you think most people like about technology in the work environment?

What do you think your colleges like about technology in the work environment?

And you?

1.2 Behaviour towards technology: dislikes

What do you think most people dislike about technology in the work environment?

What do you think your colleagues dislike about technology in the work environment?

And you?

1.3 Process (only if questionnaire data is missing or requires further clarification.....)

Is there anything that really irritates you, when a technology is being implemented? (...if so why)

What was your experience with the implementation of XY technology? Were there any issues?

What would you consider an ideal implementation process?

Thoughts and emotions

What were your thoughts prior to, during and after the implementation?

What were your feelings prior to, during and after the implementation?

1.4 Learning

Where does the ability to learn come from?

Which one of these two positions best describes your motivation (at work)? (There is no wrong or right answer – these are merely different viewpoints)

I want to deliver good constructions/developments for my company and its customers.

I want to deliver complex, challenging constructions, master difficult tasks, learn something new.

1.5 Sources for Problems

If you could choose your next design task, what kind of task would you choose? (There is no right or wrong answer...)

Not too difficult.. similar to what I've done before ... can't go wrong ... straightforward, easy to plan ... I'm SURE I can DO A GOOD JOB

Lot's too learn ... could go wrong ... I may look/feel like a fool...IT COULD GO WRONG

Everybody does something particularly well ... a design that requires my strength ... I CAN DO A GOOD JOB

Other?

If you could choose between a high quality development and a real development challenge, what would be your choice? (no wrong/right!)

high quality   a challenge

2 ORG. CULTURE UND EMBEDDEDNESS   VALUES

What values are important ....in the Company (Co) ...the work-team (WT) ... for you (Me)?

	Co not	Co somewhat	Co very	WT not	WT somewhat	WT very	Me not	Me somewhat	Me very	
habit										
structure										
dynamic										
clear processes										
routine										
order										
morality										
team spirit										
individuality										
responsibility										
consistency										
conflict										
discussion										
hierarchy										
trust										
credibility										
belonging										
communication										
reliability										
tolerance										
image										
cohesion										

Does the XY technology stand for any of those in particular?

3 IDENTITY:/ EMBEDDEDNESS

3.1 Group-identity

What groups/communities/teams do you belong to that are important to you?

Groups you belong to (if no work group is mentioned probe working context)	How closely affiliated are you to this group?	Do any rules exist?	How do you feel about those rules?	Do you experience external pressure to conform? perform/ comply; fit; obey; defy; ignore	Do you experience inner pressure to conform?

3.2 Role-Identity

In what roles do you see yourself?

What role do you see yourself in at work?	How often are you aware of your role?	Do any rules exist??	How do you feel about those rules?	Do you experience external pressure to conform?	Do you experience inner pressure to conform?

3.3 Comparison

Are you different from your colleges?   How so?

Are you similar to your colleges?   How so?

How do you prefer to work?

3.4 personal goals

What are you proud of in life?

What would you not want to do without in your working career?

What would you like to achieve in your career?

What motivates you? .What keeps you going??

What is your key source for self-respect and dignity?

inconsistency factors

Given the different roles and groups you need to consider, are there any conflicts?

If yes, how do you cope with these conflicts??

4 SELF CONCEPT: SUBJECTIVE REALITY, MEANING SYSTEM, EMBEDDEDNESS

4.1 Who am I – Test

Please complete the sentence 20x, each time using a different word or sentence that you fell it is true and applicable to yourself. (Paper was handed out and re-submitted later)

I am _____

I am _____

...

4.2 End of interview :

What stabilizes you in life?

       ... at work?

What makes you insecure/unstable? (In Life/at work)

Does technology play a role?

Do you know the feeling of not being grounded/ unrooted?

Does technology play a role?

Do you have a wisdom, understand how this world works?

A3. Questionnaire (translated English version)

Influences on Technology acceptance behaviour

Your opinion of new design software is important!

This questionnaire is a crucial part of an international research project conducted as part of a diploma thesis on technological innovations and change. The objective of the thesis is to better understand the evolution and complex behaviour related to situations of significant technological change. Your participation, help and support is very much appreciated.

You have been working for quite some time with a new software in product development. As the questionnaire is being used in parallel in the areas of mechanical design, electrical engineering and automation engineering, the software will be refered to throughout the interview simply as "new development software".

Your personal understanding and assessment is what is important to me and I would therefore like to ask you to use your personal point of view only.

The data and your answers in the research will be kept strictly confidential. For possible further queries with respect to your answers, I would though kindly ask you to provide your name at the end of the questionnaire.

Should any of my questions be unclear, you are welcome to contact me either per email (phd@hillmer1.com) or telephone 0176-43103721.

Kind regards and yours sincerely,

Ute Hillmer

Influences on Technology acceptance behaviour

Company Culture

Every company is organised differently and functions according to their own internal structures. Despite this fact, most companies though can be catagorised according to generic company characteristics.

Q1a. Which description best suites your Company?

○ Clear structures through fixed roles and processes in procedures; predominantly logical and rational methods; reliable, very effective and efficient, stable organisation.

○ Tasks and skills dominate the course of action and work assignment; result and consensus oriented team culture; flexible and fast organisation.

○ Central source of leadership (1-3 People max.); result orientated; cohesive ties dominate; felxible, dynamic, fast organisation.

○ Partnership and collaberation on demand; individualistic structure; shared power and influence; high level of self control, little hierarchy.

Other (please specify)

Q1b. Which description best fits your department?

○ Clear structures through fixed roles and processes in procedures; predominantly logical and rational methods; reliable, very effective and efficient; stable orgainisation.

○ Tasks and skills dominate course of action and work assignment; result and consensus oriented team culture; flexible and fast organisation.

○ Central source of leadership (1-3 People max.); result oriented; cohesive ties dominate; flexible, dynamic, fast organisation.

○ Partnership and collaberation on demand; individualistic structure; shared power and influence; high level of self-control; little hierarchy.

Other (please specify)

Influences on Technology acceptance behaviour

Technology Acceptance

Q2. How would you best describe your personal reaction to technology changes in your work area?

Please differentiate between your behaviour in terms of the new development software and your otherwise typical behaviour within the last 3 years.

	New Development Software	Other technology changes of the last 3
Enthusiastically	☐	☐
Complied without question	☐	☐
Initially complied, but later became uncertain	☐	☐
Initial reluctance followed by acceptance	☐	☐
Initial reluctance followed by rejection	☐	☐

Other behaviour (please specify)

[   ]

Q3. Were you involved in the inital decision to use the new development software?

○ Yes

○ No

Please use this space for further explanation

[   ]

Influences on Technology acceptance behaviour

Introduction Context

The remainder of the questionnaire focuses exclusively on your assessment of the new development software and the factors that influenced your assessment. Technolgy in general is no longer a concern.

Q4a. How important are or were the following factors for your behaviour towards the new development software?

Please note that the absence of a process can have influenced your assessment too.

	not important	slightly important	somewhat important	Important	very important	extremely important
Information Process	○	○	○	○	○	○
Communication Process	○	○	○	○	○	○
Decision Process	○	○	○	○	○	○
Training Process	○	○	○	○	○	○
Implementation Team	○	○	○	○	○	○

Other processes you consider important? (please specify)

Q4b. How did you feel about these factors?

	very negative	negative	somewhat negativ	somewhat positive	positive	very positiv
Information Process	○	○	○	○	○	○
Communication Process	○	○	○	○	○	○
Decision Process	○	○	○	○	○	○
Training Process	○	○	○	○	○	○
Implementation Team	○	○	○	○	○	○

Q5. How much effort was necessary to familiarize yourself with the new system?

	not notable	Slightly notable	somewhat notable	notable	very notable	extremely notable
Effort in terms of time	○	○	○	○	○	○
Effort in terms of learning	○	○	○	○	○	○

Influences on Technology acceptance behaviour

Networking

Which associations and relationships influenced your assessment of the new technology? Please consider all people that were relevant for your assessment and rate the relationship.

Q6. Please rate the following relationships and their importance to you, using one of the categories below for each case.
Please only rate ONE category per relationship.

Note: Job related communication refers to; exchange and relationship on a daily basis, source of professional advice
Social interaction beyond the job refers to; exchange beyond a work related contact, source of advice especially important in difficult situations

	Not important or non-existent	slightly important	somewhat important	important	very important	extremely important
Job related communication within the work team	○	○	○	○	○	○
Job related communication within the company	○	○	○	○	○	○
Job related communication outside the company	○	○	○	○	○	○
Friendly social interaction beyond your job within the work team	○	○	○	○	○	○
Friendly social interaction beyond your job within the company	○	○	○	○	○	○
Friendly social interaction beyond your job outside the company	○	○	○	○	○	○
My personal beliefs and values	○	○	○	○	○	○

Other relationships of high importance (please specify)

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Q7. During your assessment phase, how frequent was the communication within these relationships?

(Please choose the options most valid for your assessment)

	never or not applicable	Less than once a month	Monthly	Weekly	Daily	More than once a day
Job related communication within the work team	○	○	○	○	○	○
Job related communication within the company	○	○	○	○	○	○
Job related communication outside the company	○	○	○	○	○	○
Friendly social interaction beyond your job within the work team	○	○	○	○	○	○
Friendly social interaction beyond your job within the company	○	○	○	○	○	○
Friendly social interaction beyond your job outside the company	○	○	○	○	○	○
Your personal beliefs and values	○	○	○	○	○	○

Q8. How important were the convictions of the named communication sources for your decision?

	Not important	Slightly important	Somewhat important	Important	Very important	Extremely important
Company	○	○	○	○	○	○
Work group	○	○	○	○	○	○
Manager	○	○	○	○	○	○
Family	○	○	○	○	○	○
Special friends outside the organisation	○	○	○	○	○	○

Influences on Technology acceptance behaviour

Technology appreciation

These questions focus on the resulting changes created by the new development software.

Q9. How important are the changes that resulted from this technology?

Please note: The importance of the change does not reveal your attitude towards the changes! They can be positive or negative.

	Not important or not applicable	Slightly important	Somewhat important	Important	Very important	Extremely important
For me	○	○	○	○	○	○
For my work team	○	○	○	○	○	○
For my company	○	○	○	○	○	○

Q10. How do you evaluate the changes for the respective groups?

	Very negative	Negative	Somewhat negative	Somewhat positive	Positive	Very positive
For me	○	○	○	○	○	○
For my work team	○	○	○	○	○	○
FOr my company	○	○	○	○	○	○

Q11. Please tick the statements most appropriate to your level of agreement or disagreement:

	Strongly disagree	Somewhat disagree	Somewhat agree	strongly agree	Not sure
... The technology provides new opportunities	○	○	○	○	○
... The technology creates tension, anxiety and fear within my work team.	○	○	○	○	○
... The technology creates enthusiasm in my work team	○	○	○	○	○
... The technology provides new opportunities for my company	○	○	○	○	○
... The technology provides new opportunties for control	○	○	○	○	○

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Last but not least, let's focus on you as a person

Nobody knows you better than yourself. Please now reveal a little about you personally.

Q12. Which form of information and data do you prefer?

	Prefered most	Like	Sometimes like	Dislike
Graphics/Charts	○	○	○	○
3D Design models	○	○	○	○
2D Design models	○	○	○	○
Pictures/ Photos	○	○	○	○
Scientific texts	○	○	○	○
Priority lists	○	○	○	○
Process Diagrams	○	○	○	○
Multi-media presentations	○	○	○	○
Public articles (Magazines, papers)	○	○	○	○
Subject forums (Bloggs, Chats)	○	○	○	○
Discussions	○	○	○	○

Other (Please specify):

F13. How do you prefer to work? (Work team).

	Prefered most	Like	Sometimes like	Dislike
Alone	○	○	○	○
In a small team (2-3 People)	○	○	○	○
In a Project team	○	○	○	○

F14. How do you prefer to work? (Work style)

	Prefered most	Like	Sometimes like	Dislike
In clear, proven structures, problem definitions and processes.	○	○	○	○
Depending on problem definitions, sometimes strongly structured, sometime flexible and free	○	○	○	○
With lots of freedom for my own ideas, I enjoy fiddling and trying things out.	○	○	○	○

## Influences on Technology acceptance behaviour

Q15. At the time of assessment of the new development software, how do you think you felt on this scale of 1-8 ?

Two specific options are shown. Please locate your mindset between the two options.

1.

You need relationships and gain strength and power from them.

You need your privacy and gain strength from your inner resources.

. ○   ○   ○   ○   ○   ○   ○   ○
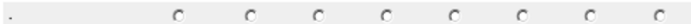
2.

You live in the present, are aware of details and move one step at a time towards your goal.

You see the future, focus on one big picture and aim for the fastest way to get to the future.

. ○   ○   ○   ○   ○   ○   ○   ○
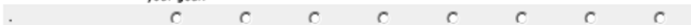
3.

You are good at analysing situations, you apply logical means and certain values are important to you.

You understand others well, value good relationships and your inner convictions are important to you.

. ○   ○   ○   ○   ○   ○   ○   ○
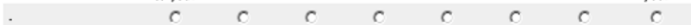
Influences on Technology acceptance behaviour

Q16. How many years of work- and apprenticeship experience do you have?

	None	Up to 2 Years.	Up to 4 Years.	Up to 8 Years.	More than 8 Years
In mechanical engineering	○	○	○	○	○
In electronics and electrical engineering	○	○	○	○	○
In automation technology and programming	○	○	○	○	○
In mechatronics	○	○	○	○	○

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and finally !

Thanks again for your cooperation and support which is highly appreciated!

Once again as confirmation: Your data from this research will be handled strictly confidential!

Never-the-less, in case of further enquiries I need to ask you to provide me with your personal details:

Name:

Company:

Please describe you job repsonisbility:

Email Address:

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