Understanding Information Technology

Information technology as extension and its implications for the flourishing of the individual

Wouter Versluijs

Master Thesis
Philosophy of Science, Technology and Society
University of Twente

Wouter Versluijs: s1015524

Supervisor: Prof. Dr. Philip Brey
Examiner: Prof. Dr. Ciano Aydin

December 15, 2015

Abstract

In this thesis a systematic account of information technology is developed in order to uncover general ways in which it affects human flourishing. The idea of technology as an extension of the human being provides the basis for the account of information technology, more specifically Brey's extension thesis that all artifacts extend the set of naturally given means by which human intentions are realized. This extension thesis is elaborated upon and then used to investigate the different ways in which information technology is an extension. In that way the following relevant steps of development are distinguished: Early computers, which cognitively extended the human being in order to realize organizational intentions; advanced computers, which made it possible to extend material entities by means of its simulation function and enabled the realization of individual intentions; the introduction of the internet whereby locations, human interaction and new material means could be extended to realize intentions also on a shared level; and finally the availability of portable information technology which enabled extension of the mind and the extension of even more material means. Because the development of information technology is accumulative, today's artefacts can encompass all these extensions within a single device.

These conclusions concerning information technology provide the basis for a normative understanding on a general level. To develop such understanding, an appropriate approach was developed which encompasses the Capability Approach with a perfectionist understanding of what flourishing means, focusing on the opportunities for the human individual to develop himself. This leads to the following conclusions:

1. By means of the extension of information technology, intentions can be realized very efficiently and conveniently, but the way this realization becomes a commodity is a threat to other more valuable ways to realize those intentions.
2. The cognitive and material extension of information technology overcome the limitations of the means that are extended, but in that process the body can become experienced as 'just' another extension and the faculties of the body become disvalued.
3. Because information technology can extend many sets of means at once, it provides many different 'presences' simultaneously. This can cause valuable presences to be disturbed and frustrates the user's ability to focus on a specific activity.

Information technology thus naturally propagates efficiency and convenience but thereby threatens opportunities for the individual to develop himself, to flourish. These effects depend on the alternative means to realize intentions an individual has access to in the first place; in affluent countries individual flourishing is generally more threatened by information technology than in situations in which opportunities to develop oneself are not a matter of course.

Acknowledgements

Writing this thesis to complete the master Philosophy of Science, Technology and Society has been an experience with many different facets. It has been a challenging, interesting, daunting and exciting period, mixed with a little melancholy because it also means the end of the master that proved the most challenging, entertaining and interesting part of my education. This graduation project also felt to me as a transition from student to 'citizen', not just in finishing my (first) master, but also as this thesis project began by writing from my room in my student house, simultaneously finishing my year as chairman of our study association Ideefiks, and finished while writing from the study room in the house where I live together with my girlfriend, combining it with a part time job at the university spin-off Rhythm. It has also felt as a very rewarding experience to dissect the nature and effects of the media which I was simultaneously using to produce that master thesis. I saw how for instance my conclusions concerning the role of the body in information technology and its distracting nature were not just theoretical implications but were aspects that I was experiencing myself, for example when trying to keep my focus without being distracted by all the possibilities for entertainment on the internet or when forcing myself to get out of the house instead of sitting a whole day behind the computer with almost zero bodily exertion.

I sincerely thank all who were involved during my master in general and during my thesis especially. First of all my thanks go to my supervisor, Professor Philip Brey, for all his help and feedback during the project, and Professor Ciano Aydin as examiner, for helping me finish this thesis properly. Then I want to express by thankfulness to my friends and co-philosophers of Ideefiks, for making the PSTS experience even more rewarding and interesting; to all staff of PSTS who help sustain this great study and opportunity for students to dig deeper; to my family for providing such a great home base and to my mother especially, for far surpassing her motherly duties during my project; to my colleagues of Rhythm who showed that there also exist inspiring people outside the philosophy domain; to my friends of Arriba, Industrial Engineering and others for inspiring me and providing the necessary distraction; and finally to Ashley, for everything.

Table of contents

Chapter 1: Introduction

What do Mahatma Gandhi, Franklin D. Roosevelt, Adolph Hitler, Joseph Stalin, the Computer, Mark Zuckerberg and Pope Francis have in common? Each of them has been profiled by Time Magazine as 'person of the year', because he, she or it "for better or for worse... has done the most to influence the events of the year" (Rothman 2014, Hanman 2012). It was in 1982 that the Computer was featured by Time Magazine and arguably the decades since then the computer has had an even bigger impact on not only the news-worthy events that took place, but also all the other activities, habits and pursuits that the average human encounters in daily life. Considering how much has changed in the way we work, study, communicate and spend our free time, a world of difference seems to distinguish today from the pre-computer area of only a few decades ago.

Time Magazine refrains from giving any value claim when choosing a person of the year. It however seems vital to gain an understanding of what the computer, and information technology in general, is, what distinguishes it from earlier technologies, and how it affects us as mankind. Do the electronic information devices of today contribute to mankind, enabling man to reach goals never attainable before? Or do these technologies actually endanger our humanness?

Certain specific aspects of information technology have been scrutinized in this light to consider how they affect the human being. As a technological development on a general level, the effects of this revolutionary technology have however not been systematically investigated or understood. It then also seems a daunting task to analyze information technology as a whole, considering the many different aspect of not only information technology but also the life of the human being. There are clearly many sides to the story. However, we can at least try to understand this story; what information technology is and does. Getting a grip on whether information technology has certain innate effects on mankind is clearly a worthwhile endeavor and one that has as of yet barely been embarked on.

In this thesis, I will develop such a systematic understanding of information technology at a general level. To develop this, first some idea is needed of not just what information technology is, but also how the human being relates to it and can be affected by such technology. With that, we can try to understand the effects of the arguably most important technological developments of the recent decades.

1.1 Research subject and research question

The aim to understand the relation between the human and technology is part of the larger tradition of philosophical anthropology. This tradition tries to define and understand what it means to be human. One such way of understanding, is to see the human as being inherently 'technological'. Gehlen (1940) for instance argued that the human is a 'Mängelwesen", that needs technology because he lacks natural attributes, which makes him unfit for fighting (lacking claws or sharp teeth) and flight (not quick enough) and vulnerable to weather conditions. Instead, the human needs tools to manipulate the environment and thereby reap the resources it has to offer. Ernst Kapp observed that those tools have remarkably much in common with the limbs the human is naturally equipped with; the hammer works like an arm, the telescope like an eye and clothing like the skin. This led him in 1877 to formulate the first work that called itself a 'philosophy of technology', where he worked out this idea of *Organprojektion*. It was this idea of Kapp, that technological artefacts resemble parts of the human and thereby extend his

capabilities that would lead later authors to further investigate how technology can be understood to mimic or 'extend' the human being. This field is now called *extension theory*.

Extension theory has seen some important authors, especially Marshall McLuhan has famously used it to understand the media that emerged in his time - the television and radio. Would it not be interesting to use this perspective of technology – as an extension of the human being – to develop an understanding of the dominant technology of our time, information technology? Steps have been made to develop such an understanding, by explaining certain computer phenomena by means of extension theory, but information technology as a larger development in the human timeline has not yet been researched from such perspective. This is an interesting gap to jump into, because it can shed a new light on information technology and its role in the life of the human. Such perspective is not only interesting on itself, but can also provide a basis to normatively evaluate the impact information technology. Thus by using extension theory to gain an understanding of technology, I can develop new insights into what constitutes information technology and its relation with the human and thereby contribute to understanding the implications of information technology for the human. I will thereby focus on the everyday life of the human individual. As I will show, this focus fits best with extension theory, and trying to encompass all effects concerning all of the human lifeworld (i.e. politics, nature, nations, wars, research, economics etc.) would be an impossible task. The research question of this thesis therefore is:

> *"How can information technology be understood as an extension and in which general ways is the flourishing of the human individual affected by this extension?"*

To get to an understanding of information technology in this way, I need to take two steps: First an understanding of information technology as extension has to be developed. I will compare different accounts of extension theory to consider what their strengths and weaknesses are, to end up with an extension account that can be used to analyze information technology. When such an extension account of information technology is established, I can use this to analyze the normative implications of this account.

1.2 Chapter outline

To take both these steps and answer the research question, I need to answer certain subquestions that will accumulate to an understanding of information technology that is both philosophically valuable and practically interesting. Below I will present these subquestions and the set-up of the chapters in which they are answered.

Chapter 2: Extension theories of technology

In the second chapter, the field of extension theory of technology will be introduced. The classical theories of Kapp and McLuhan will be discussed, followed by an analysis of the modern state of extension theory. In this way the subquestion will be answered:

1.1 *What is extension theory and with which technologies are existing accounts of extension theory concerned?*

Subsequently, different contemporary extension theories will be discussed and one will be highlighted and further elaborated as an extension theory that can provide the basis for the development of an understanding of the extension of information technology. This will answer the subquestion:

1.2 *What is a sophisticated and appropriate extension theory to investigate information technology?*

Chapter 3: An extension account of information technology
In the third chapter, information technology will be investigated as to how it can be understood as an extension. To get a grip on what information technology is, its evolution is researched: First an understanding will be drawn of the very first information technologies, after which its subsequent developments are understood from the perspective of extension theory, concluding with the high-tech smartphone and computer technology of today. In this way the following subquestion will be answered:

2.1 *How can (different) information technologies be understood to be technological extensions?*

After having understood how information technology can function as an extension, an interesting matter is how this extension is similar or different from the technological extension of artefacts from earlier phases. Therefore, the understanding of information technology will be put into this larger perspective, which will answer the subquestion:

2.2 *Is the extension of information technology different from the extension of technologies from earlier technological phases?*

Chapter 4: Normative implications of the extension account of information technology
In the fourth chapter, it is investigated what the implications of this understanding of information technology are for the human being. This is done by means of the extension account of information technology established in the third chapter. To analyze this account, first an approach has to be established that can help understand the dynamics of the extension account of information technology from a normative perspective. Therefore, the following subquestion will be answered:

3.1 *How can the impact of the extension of information technology on the flourishing of the human being be analyzed?*

With the normative account that will be established as the answer to subquestion 3.1, it will be investigated how the extension of information technology generally affects the human being in his beings and doings and how the extension of information technology improves or frustrates his flourishing. In that way, the subquestion is answered:

3.2 *In which general ways is the flourishing of the human individual affected by the extension of information technology?*

Chapter 5: Conclusion
In the fifth chapter, the conclusion of the preceding chapters will be summarized. The answers to these subquestions will be used to answer the main research question of this thesis:

"How can information technology be understood as an extension and in which general ways is the flourishing of the human individual affected by this extension?"

With this objective set, let us commence on a story of information technology that of yet has been untold.

Chapter 2: Extension theories of technology

In 1877 Ernst Kapp published *Grundlinien einer Philosophie der Technik*, the first work to present itself as a study in the philosophy of technology (Steinert 2015). In that work, Kapp argued that all technological artefacts are projections of human organs; unconsciously mankind has reproduced its body parts and organs in its tools. Kapp called this 'Organprojektion'. The hammer for instance mimics the arm and fist, and telephone wires mimic the nerves.

Kapp's understanding of technology, as a direct projection of the human organism, has by now for long turned out of fashion. Kapp however laid the basis for the idea that technology in some way *extends* the human organism. This idea has seen revivals throughout the history of philosophy of technology and has also in contemporary work received attention. This is because - although Kapp's philosophy could be disproven by counterexamples such as the lighter or magnet, which have no bodily counterparts (Brey 2000) - the idea of technology as a kind of extension of the human can help in understanding what technology is and how it can be distinguished from other entities. It can be a key to discover characteristics of specific artefacts, develop ideas concerning the role of a specific technology in the lives of man and society, analyze how artefacts have evolved and explore what their impact is on the human way of living.

Different accounts that succeeded Kapp's philosophy of technology developed different ideas of what this *extension* of the human actually means. They are concerned with what it is that is extended, and how this way of extension affects questions concerning technology, mankind and society. There is no unified way to comprehend this idea of technology as an extension, but there is a field of *extension theory* that does so in different ways. It is this subfield within the philosophy of technology that I will investigate in this chapter, to provide a framework for my thesis. I will research the different extension theories that exist within this field and argue what their strength and weaknesses are. In this way, I answer the subquestion:

1.1 *What is extension theory and with which technologies are existing accounts of extension theory concerned?*

This literature framework will make it possible to arrive at an extension theory that will allow me to research information technology in the later chapter of this thesis. Establishing such theory will answer the second subquestion of this chapter:

1.2 *What is a sophisticated and appropriate extension theory to investigate information technology?*

I will begin this investigation by considering the two most classical accounts of extension theory; that of Ernst Kapp (1877) and Marshall McLuhan (1964). These authors have turned out of fashion, but by discussing their ideas, I will show the history, but also the contemporary importance and relevance, of extension theory. After this discussion of the value of extension theory, I will use Steinert's (2015) categorization of extension theory to investigate more modern developments within extension theory. This investigation will conclude with a sophisticated extension account that can withstand extension theory criticism and will serve as a theoretical basis for the third chapter.

2.1 Classical extension theory

In this section I will shortly consider the two most important 'classics' within the field of extension theory: Ernst Kapp and Marshall McLuhan, to show the basic ideas of extension theory and the roots that lay the basis for more contemporary extension theories.

2.1.1 Groundworks of extension theory: Ernst Kapp (1877)

Kapp's work was already shortly introduced, but let us reflect on his work a little longer, because it is important to comprehend the actual idea of extension theory that it gave birth to. First, although the hammer gives an intuitive introduction into Kapp's understanding of technology, his philosophy also comprehends more complex examples of *Organprojektion*. These are for instance the ideas that the human nervous system is reproduced through the telegraph network and that the steam engine mimics the whole human organism, where coal serves as food (Brey 2000, Steinert 2015).

Furthermore, Kapp did not just recognize these projections, he also used this idea to normatively assess the role of technology. He argues, by means of his own 'extension thesis', that technology only actually serves man when it does indeed reproduce his bodily means in a way. When a technological artefact does not mimic the body's limbs or organs, it only exists to work in some existing technological system. If this is the only goal of a certain artefact, to fit into some technological system, it does not actually contribute to mankind. In that role technology can even limit human freedom, culture and security (Brey 2000).

Thus although contemporary writers use counterexamples to disprove Kapp, his work has value; it shows a specific kind of understanding of technology and how such an understanding can be used for further reasoning on the impact of it on humanity. After Kapp's attempt of writing a comprehensive philosophy of technology, it would take almost a century before a substantial work concerning 'extension theory' would again be published. It was in 1964, that Marshall McLuhan published *Understanding Media: The Extensions of Man*.

2.1.2 Extension theory and media: Marshall McLuhan (1964)

Marshall McLuhan had a different agenda than Kapp. He tried to understand not just technology in general, but media and more specifically the media of his time and their impact. The other most important difference with Kapp concerning content is that McLuhan did not focus on the human body that is reproduced through technology, but on functions of the mind that technology can 'extend'. Brey (2000) formulates the distinction that McLuhan makes to be that between *extensions of the body* and *extensions of cognitive functions*. Extensions of the body are those of the mechanical age; the extension of parts of the body that are used to act within the environment or to control one's bodily functions. Technologies that extend these are for instance spears and knives, clothing and vehicles. Extensions of cognitive functions extend functions concerned with the senses, the central nervous system, or even consciousness itself. The most important examples of such extensions are the modern media, McLuhan's focus: The radio and telephone extend our hearing, writing and print extend the visual function and electric media are considered to be extensions of the information processing functions of the central nervous system.

What the reader might have noticed in the above, is that McLuhan let go of the idea that technologies directly mimic parts of the human. This is because McLuhan was not concerned with morphological similarities, but with the *function* that is extended. Thus not the ears, but the function of hearing is extended through the telephone and clothing is not a mimicking of the skin, but an extension of the bodily function of heat control and protection (Lawson, 2010). With this new understanding of the extension of technology, McLuhan was able to further explain technological phenomena, but not to encompass all examples that were used to criticize Kapp's work. Brey (2000) gives examples of technological artefacts that do not seem to extend specific functions of the human body or cognition and thus are counterexamples for McLuhan's extension theory: electric lighting, explosives and roads for instance. It could be argued, in defense of McLuhan, that such technologies correspond to human faculties in more abstract ways, but this does make the ideas presented in McLuhan's extension theory increasingly hollow.

McLuhan, like Kapp, uses his extension theory to criticize certain forms of technology. He sees a human being in the electronic age that "wears its brain outside its skull and its nerves outside its hide" (p.57). He argues that this extension leads to a 'numbing down' of the senses that are extended through those technologies. There is a danger of 'self-amputation' of the functions that are extended through technologies such as television and radio and we might even become susceptible to commercial exploitation of these functions, as parties "try to benefit from taking a lease on our eyes and ears and nerves" (McLuhan 1964, p. 73).

McLuhan thus presents a comprehensive work on media and what their extensions mean, but this account loses part of its value because of the counterexamples his philosophy cannot account for. Furthermore, McLuhan's extension theory cannot to a coherent degree be used to help in the understanding of other phenomena than the ones he describes, because his use of language and examples is so specific, and because he never clearly establishes his 'extension theory'. As said, the most important aspects are that of a focus on functions, instead of physical body parts and that McLuhan also takes mental functions into consideration.

Although after Kapp's, also McLuhan's extension theory would turn out of fashion, those two elements – concern for mental as well as bodily functions and not a literal conception of 'extension' – would provide a basis and inspiration for new extension theories in modern literature in the philosophy of technology.

2.2 Modern extension theories

Whereas Kapp and McLuhan are generally seen as the main classical authors of extension theory, there is not a specific work that serves that role in modern literature of philosophy of technology. There are two reasons for this. First, extension theory was conceived as meaning different things and this led to different versions of extension theory. Second, extension theory as such was increasingly criticized and other philosophies of technologies got more dominant positions. The main attacks on extension theory accused it of containing flawed ideas of instrumentalism and technology as a neutral intermediary between the human and the world. While also Kapp's and McLuhan's extension theories can to a certain extent be defended against these criticisms as I will show, it is most worthwhile to now first discuss today's field of extension theory, as these theories already searched for ways to further debunk the

critics of extension theory and overcome the limitations of the previous extension theories. After the discussion of the categorization of extension theories and after having formulated an appropriate extension theory, I will further discuss these critiques in section 2.4.2.

2.2.1 A categorization of extension theories of technology

The field of extension theory is all but homogenous and Steinert (2015) therefore made an effort to establish a categorization of the field in present day. This leads him to identify the following four versions, of which some have a larger presence today than others:

1. Technology as an extension of the human organism
2. Technology as an extension of the lived body
3. Technology as an extension of human intentions
4. Technology as an extension of human faculties or capabilities

Within these categories, I search for an extension theory that is both (1) able to withstand the main criticisms of extension theory and also has additional value as a theory, and (2) provides an appropriate basis for this thesis to research the extension of information technology. As said, I will first focus on this second point, as relating each of the theories to the general criticism would make this section unnecessary extensive. After having chosen an appropriate category and extension theory, I will further discuss the theory by means of the general critics of extension theory. Let me now first address each of the versions and explain what their value is and why they are or are not appropriate to further explore in this thesis:

The first version of extension theory is mainly occupied by Kapp's philosophy of technology, which is concerned with technological artefacts as extensions of the human organism. This philosophy of technology takes technology to be an extension of the human body through artefacts mimicking body limbs. It did not get much further attention by subsequent authors. Although Kapp's ideas are enticing, they too soon fall apart with the many technological artefacts that do not directly resemble a part of the human organism, such as the lighter and telephone.

As second version of extension theory, Steinert distinguishes 'technology as an extension of the lived body'. In this version, Steinert places phenomenological accounts of sensory extensions and bodily incorporation of technological artefacts. These are concerned with the extension of technological artefacts in a quite literal sense. These theories also do not encompass an understanding of all technological artefacts, but of specific artefacts that they see as extensions of the lived body. Merleau-Ponty's (2003) ideas, concerning the incorporation of external means into our body as open system, are part of this category, which can bring an understanding to for instance the driving of a car or the use of a blind man's cane. Also Ihde's (1990, 2002) conceptualization of the embodiment relation between human and technology, in which perception is materially extended is part of this version. Merleau-Ponty's and Ihde's philosophies of technology indeed concern an extending function of technology, but these are of quite a different nature than which we are concerned with here, and are not per se related to an extension thesis of technology: We are concerned with the questions on the genesis, development and essence of technology, like Kapp and McLuhan were. The authors that Steinert discusses under this version are more concerned with the relation between the human and technology, and the role

technology plays in the relation between human and the world. Although these philosophies of technology have received much discussion and credit, they will not be further discussed here because they concern a different 'identity', or subset, within the field of philosophy of technology; a different one than is at stake in the current discussion of extension theories of technology.

The third position Steinert distinguishes - technology as an extension of human intentions - concerns the philosophy of technology that was formulated by Rothenberg (1993). Rothenberg argued it to be essential that technologies are 'carriers of our intentions'; through use of technologies intentions are extended. These intentions form an intermediary between desires and the external world. Telescopes for instance extend our intention concerning further vision and acuity and a scarecrow extends our intention to keep birds away from a lawn. Rothenberg's philosophy of technology has been heavily criticized for taking an instrumentalist view of technology and for being too vague or trivial. His theory has however been used as a vehicle for more sophisticated accounts, which concern the fourth version in Steinert's categorization.

The fourth version of extension theory - technology as an extension of human faculties or capabilities - is a broad one. This version of extension theory started with the work of Marshall McLuhan, already discussed in chapter 2.1.2. In modern philosophy of technology, the two most relevant works that take this as a starting point are those of Brey (2000) and Lawson (2010). The basis of these works is McLuhan's concept of technology as extension of human functionings: that we do not have to limit the idea of the extension of technology to the literal, or mimicking extension of bodily organs. Whereas Rothenberg focuses on the extension of intentions, both Brey and Lawson criticize it and elaborate to a theory that revolves around the extension of capabilities or faculties. As such they take McLuhan's idea of the extension of human functions as a starting point and develop it in order to establish a more sophisticated extension account of technology.

The four categories discussed above thus form the contemporary field of extension theory. I had already discussed the classical works of Kapp and McLuhan and have now discussed all main accounts of extension theory that exist within the field. This has formed an answer to the first question of this chapter:

1.1 *What is extension theory and with which technologies are existing accounts of extension theory concerned?*

Extension theories thus develop an understanding of technology as the extension of the human being. Kapp was the first to do so and was concerned with mechanical technologies mimicking the human organism. McLuhan focused more on the way electric media extended the senses. Concerning the modern field of extension theory, I discussed four categories: those concerning technology as an extension of the human organism, theories that see technology as an extension of the lived body, extension theories that understand technology as an extension of human intentions and finally accounts that develop an understanding of technology as an extension of human faculties or capabilities.

2.3 Establishing an appropriate account of extension theory

Having established an understanding of the main extension theories, it is now time to elaborate on one as basis for the subsequent parts of the thesis. Therefore, we turn to the second question:

1.2 *What is a sophisticated and appropriate extension theory to investigate information technology?*

We now have to evaluate which theory is most appropriate to use in the subsequent chapters to develop an understanding of information technology. To establish such theory, first the most relevant 'version' of extension theory from Steinert's categorization can be determined, afterwards a more specific theory can be established.

2.3.1 An appropriate version of extension theory

In the above discussion of the different categories, I already introduced a few conclusions concerning the relevance of the different categories: The first version is clearly outdated due to the many possible counter examples. The second version seems not appropriate to understand information technology as a development on itself, as it is concerned with specific artefacts and the third one is too vague as basis of understanding information technology and has been very heavily criticized. There are two further main positive reasons why the fourth version of extension theory - technology as an extension of human faculties or capabilities – is most valuable for further elaboration:

First, it is able to encompass all technological artefacts and consider how they extend human faculties; it does not limit itself to artefacts that mimic the human body as the first version does, or to artefacts that literally extend like the second version does. This is beneficial and more appropriate for this thesis because it allows an understanding of information technology as a technological development, instead of an understanding of only specific information technological artefacts.

Second, the fourth version brings an understanding of both the development of technology and of the nature of technology that can encompass all stronger points of the other (earlier) versions of extension theory, but is able to circumvent the downsides of those accounts: The understanding of technology as an extension of faculties or capabilities still allows evaluating some artefacts to for instance mimic the body or to literally extend it, but can do so within a framework that allows the evaluation of every technical artefact in general, and it is much less vague or trivial than Rothenberg's ideas. It is in these ways that the fourth version of extension theory is most promising as fundament for the subsequent chapters. To further explore this, I elaborate on this fourth version of extension theory in the next section.

2.3.2 Technology as an extension of human faculties or capabilities: Philip Brey (2000) and Clive Lawson (2010)

There are two main contemporary articles within the fourth version of extension theory: *Theories of Technology as Extension of Human Faculties* by Philip Brey (2000) and *Technology and the Extension of Human Capabilities* by Clive Lawson (2010). These two theories show similarities with each other in that they concern both bodily and mental faculties and that they are concerned with the extension of those faculties or capabilities. Steinert (2015) therefore discusses Lawson's and Brey's extension theory simultaneously, as he argues that although there are small differences, the similarities are crucial. I will

here show that there are however more important differences and that these make Brey's formulation a better basis for a sophisticated extension theory than Lawson's theory.

Lawson's (2010) main objective is to find what the defining aspect of technology is. Lawson argues that artefacts need to be enrolled in technical and social networks of interdependencies, to realize an extension of a *capability*. He links this idea of a network of ties of social and technical nature to Latour's Actor Network Theory. This is what leads him to the idea that the extension of technology consists of an enrolment in existing network of interdependencies. A padded bar to prevent a child moving in a car is for instance an extension of a parent-driver's power over his or her child and is enrolled into the technical relations of the car and the social relations of parent and child and larger relations such as those of the etiquette of 'good parenting'. This is an interesting perspective, but Lawson seems to leave out an explanation of what it precisely is that is extended and how technologies do this and do this differently than other entities. He does not explain what kind of capabilities we should think of that technologies can extend, nor does that become obvious by reading his paper or does his paper provide a way to discover this extension in artefacts as reader.

Brey (2000) on the other hand, starts at the very basis of extension theory and asks why in the first place technology is used and from there works towards an understanding of what these artefacts extend. Brey's point of departure is that human beings continually try to realize their intentions; they try to change the world so that it corresponds to their intentions. He says that for the human, initially bodily and mental faculties provided the 'original means' to manipulate the world in order to realize these intentions. The role of technology is to extend, or add to, these means for manipulation of the world. If apples for instance hang too high to reach with one's 'natural means', i.e. the arms and body, one could extend this set of means with a ladder or a stick to be able to realizes his intentions. Brey summarizes his extension theory in the following thesis: "All artifacts extend the set of naturally given means (i.e., human bodily and mental faculties) by which human intentions are realized" (p.9).

Steinert does not differentiate between Lawson's and Brey's extension theory and indeed Lawson and Brey's works do not seem to contradict each other. As Brey claims that technology extends the set of naturally given means, Lawson sees technology as extending capabilities. It could indeed be argued that *capabilities* are *a set of means to realize intentions*, which shows that the basis of the two extension theories can be considered the same in this regard. However, while Brey explains how this set of means originated and provides a basis to understand all artefacts, Lawson takes the capabilities as a given and subsequently asks how these capabilities are in practice realized (by enrollment in a network of interdependencies). Lawson is not clear in his characterizing of what an extension is and thereby his extension theory does not provide the opportunity to explore other artefacts in any interesting manner. Thus whereas the understanding of Brey and Lawson of what an extension is closely resemble each other, Brey provides a much better basis to subsequently analyze specific artefacts other than those described in the article.

Because Lawson's article was written later than Brey's, he had the chance to also criticize Brey's extension theory. Lawson argues that it is left unclear in Brey's thesis what is exactly meant by the term 'extension' and what it is that is being extended. Lawson says that if Brey is talking about a set of means

being extended, it might make more sense to simply talk about technology 'adding to the means' and if extension is used to express an extension of the human agent, the question remains what then is extended of this agent.

Brey's theory can be defended against this criticism, because what his thesis impressively does, is to bring back the extension thesis to its very core, which he formulates as "the extension of the set of naturally given means". By focusing on this essence of extension theory, he does not strictly impose a certain kind of extension, but gives a key that can be used to further explore different kinds of extension. Because in Brey's extension thesis, it is not directly established what the extending role of technology in detail is, it provides space to further conceptualize a more specific extension. By investigating the set(s) of means an artefact extends, we can develop an understanding of that artifact's characteristics. This is different from simply seeing the artefact as 'adding to the means', which would not allow a further interesting evaluation. Such a set of means that is extended could thus indeed for instance be an extension of the human being, which can then subsequently be further investigated. Thus, I disagree with Lawson that it is a limitation that it is not directly clear what is being extended from Brey's thesis, but argue that it is a strength, because it allows further theorizing on these matters, which could be done from different perspectives; a strength that his own extension theory does not have. For this reason I take Brey's extension thesis as basis of the further research in this thesis.

Let me in the next subchapter first discuss Brey's extension thesis a little further and then turn to the extension critics and how their arguments relate to this extension theory.

2.4 A sophisticated extension theory

I have now discussed classical extension theories, their value and why they have turned outdated, and I have considered modern extension theories and argued that Brey's (2000) is the most appropriate extension theory to use as basis in the remainder of this thesis. I will here further explain Brey's extension thesis. I will then make a subtle adjustment to the extension thesis, which allows a more fundamental analysis in the next chapter. With this basis established, I will discuss it in light of the extension critics. In addition, I will elaborate on the distinction between individual and collective extensions that Brey makes and further conceptualize these possible kinds of extension.

2.4.1 The extension thesis

Let me first recite Brey's original extension thesis, because it formulates the core of his extension theory: "All artifacts extend the set of naturally given means (i.e., human bodily and mental faculties) by which human intentions are realized." (p.9). In this way, Brey takes the 'naked' human faculties to constitute the original 'tool set'. The next step of thought is that this original set of means can be extended by external entities. These either enhance existing capacities, or add novel capacities. These extending entities are not only of a technological nature; also natural objects, such as rocks, can extend the human organism and even other human beings or animals can be considered as extension. The distinguishing feature of technological artefacts is however that these have been intentionally designed to function as extensions and the thesis allows us to analyze its genesis and subsequent development.

While Brey provides a broad but valuable definition of extension, he does confine the idea of what a technology can extend. He does this by clarifying between brackets that under the set of naturally given means that can be extended, the reader should understand those to be the human's bodily and mental faculties. While this seems a small addition to the understanding of extension he gives, Brey hereby seems to overlook that there are also other sets of 'naturally given means', which might be extended. While the human indeed has his own means (i.e. body and mind), these are not the only ones used to realize intentions. There is also a world out there with other entities that can be manipulated by the human to fulfill his desires. We should not exclude the idea that technology could also extend these sets of naturally given means. This idea of the extension of other entities than only the human originated by Brey himself (cf. Brey 2005; Brey 2008), but has not been anticipated in his extension thesis.

I will later (in section 3.1.2) explore this idea much further as it is very relevant for the understanding of information technology. Let me here provide one fictional example of what the extension of the worldly natural set of means might mean:

The resources of the world naturally provide us with food to realize the intention of satisfying the need for food. We cannot realize this intention with only our bodily or mental means. Now say that it would be possible to somehow technologically *imitate* (or simulate) such a natural source for food; an apple tree for instance, which would provide fruit that would also satisfy our hunger to some extent. This source could be in the form of a tree, or a completely different technological device. A technology that would provide such a source, would be an extension of the set of means to realize intentions of satiating hunger. This is thus not an extension of the human organism, but of an external set of means. It is with that reasoning that we should not narrow down the technological extension of merely the naturally given human means.

Whereas extension theory generally focused on technology as an extension in some way of the human organism, i.e. his body and mind, we might thus have to alter this idea and incorporate the observation that technology can extend external means as well. The human 'originally' had access to his own internal means and the external means of the environment to realize his intentions. Technology can add to these by extending these sets of means.

With this observation, I will understand the extension thesis as follows:

"All artifacts extend a set of naturally given means by which human intentions are realized."

As said, I will later further elaborate on the role of technology as extension of external means, as then further elaboration and examples can be given when we turn to information technological artefacts. I will then also discuss to which extent there is a hard distinction between these two 'kinds' of extensions.

2.4.2 Critiques on extension theory

In this section, I will discuss the extension thesis that I have just established by means of the main critiques on the idea of technology as an extension.

First, it should have become clear that in regard to the specific critiques on other extension theories, the presented extension thesis overcomes the main limitation of earlier theories that not all artefacts could

be analyzed. Whereas Kapp's and McLuhan's understanding of extension could be criticized with certain counterexamples, the adapted version of Brey's extension thesis allows the investigation of all artefacts by understanding how they are an extension of a set of means. As such this thesis can also be used to analyze artefacts on various levels, as for instance a car could be investigated as an extension of the legs, but also additionally as an extension of the broader set of means to display one's status. Like I already argued, this is a strength of this extension theory, as it provides an understanding of technology that allows us to analyze the characterizing features of technological artefacts.

Let me now get into the main criticisms on extension theory in general. Kiran and Verbeek (2010) criticize what they call the 'extension idea' in a way that also summarizes the most common critique on extension theory, as follows: "The main problem with the idea, whether in the form of mind extension or any notion of body or organ extension, is that technologies [sic] is seen as extensions of or substitutions for *inherent* human capabilities. […] [T]echnology is seen as nothing but a *transparent intermediary* between the world and us." In a reaction to this article, Heersmink (2011) has made an effort to defend extension theory against Kiran and Verbeek's claims. He has done that especially by referring to the fact that extension theory is not a unified field, but a collection of philosophies which all argue for different kinds of extensions of the human. Heersmink provides examples of theories that can withstand these criticisms. I think there are however more arguments that can be used to defend extension theory against the claim that it contains 'residues of instrumentalism', which I will discuss here:

In addition to only defending what Heersmink distinguishes as 'strong extension theories', I find Kiran and Verbeek to be mistaken in general when they accuse extension theory to propagate a neutral view of technology. Extension theory does not claim that technology neutrally allows the human to perform certain functions; it actually, by means of the concept of extension, tries to understand how technology is inherently part of both the human and world. It can be used to analyze the characteristics of *how* a technology is used to realize intentions, instead of only regarding it a neutral means to these intentions. Extension theory attributes technology a role that is both part of the human and of the world and by exploring this role we can undo technology from its neutral appearance and can uncover how technology affects this human and world and is affected by these; effects that are certainly not transparent. Kapp and McLuhan already used the extension idea in order to understand such affects and later extension theories have only ventured further away from the idea that technology is a mere tie between the human and the world, instead of part of the combination of both. Understanding the hammer as an extension of the arm for instance – part of the most basic understandings of extension - already has implications for what we understand the human body to be (e.g. a body of power), how technology affects this (e.g. by making interhuman differences in power less important), and how the world is and can be affected by this technology (e.g. can now be seen as more vulnerable to the power of the human). Extension theory in general thus does not understand technology to be something neutral and can actually serve as a basis to explore what is then the role and impact of technology.

The second main critique that is reflected in Kiran and Verbeek's criticism is that extension theory is flawed because it sees technology as an extension of *inherent* human capabilities. This critique is also encountered in discussions concerning mind extensions, as criticists like Aydin (2013) claim there that the idea of original 'inside' that could be extended is flawed, as cognition is a process in which brains,

bodies and the world simultaneously participate. In first instance this might seem a fundamental critique on extension theory, if one would understand the extension idea as saying that first a function is inherent in the human and that technology can subsequently extend this outside in order to manipulate the world. The first extension theories might indeed resemble this refuted line of thought, but I believe the proposed extension thesis here does not. It says that sets of means are extended and within this concept we can incorporate the idea that those means can exist just as much within the human as outside him. While we might consider means as extensions of the human's natural sets of means, this does not limit us from understanding those means as emerging from the process of interaction with the world, that they are never truly 'inside' the human. As such, this extension thesis focuses on extension of sets of means that arise from the interaction between the human and the world and can thereby already see means as not being inherently human or worldly. While this idea is not explicitly formulated in extension theory in general, this does not mean that extension theory should be criticized for taking the opposing view. Furthermore, it should be understood that extension theory as described here does not have as goal to ontologically understand what cognition is or how cognitive functionings come to being, but to uncover the characteristics of specific artefacts. This means that while for instance a snowstorm could distract us, change our mode of thinking and thereby affect and interact with our cognition, this is not per se philosophically interesting as a function of a snowstorm; this effect on cognition does not particularly enable the human to do or be something. A calculator however has as its function to interact with and (depending on the understanding of extension) even take over part of our cognition. For a calculator it is thus much more interesting to analyze the effect of the way cognition is extended in order to grasp what it is and does than for a snowstorm, which is exactly what extension theory allows us to do.

The claims that extension theory sees technology as something neutral and maintains an inside-outside distinction are in the context of this thesis thus unjustified. Another argument that has been posed to attack the proposed extension theory, is that technology is much more than only a means to realize intentions. I think this is definitely true. Important and interesting other ways in which technology affects the human and world are for instance: By being *potentially* available or even being *un*able to realize a certain intention (Kiran and Verbeek 2010); by affecting or even creating intentions (Tupa 2012); by frustrating certain functions instead of creating them; or by performing different functions than the technology was originally designed for (Kiran and Verbeek 2010). I have no intention to refute these claims that technology has many other relevant aspects. However, I think it is a mistake to think that extension theory cannot account for these. First of all, extension theory can on itself actually encompass and analyze these effects to a certain extent. By understanding how information technology extends set of means, we can not only analyze it when it is used to realize an intention, but also how it can affect man and the world already by merely being available for potential use. Similarly, by means of extension theory it is possible to analyze all sets of means to which an artefact forms an extension, instead of only the set it was originally designed for. Furthermore it should be clear that in extension theory we do not just regard to which intention a technology *is* used, but also *how* it realizes intentions, which is the main way to get insights into the nature of that technology. Extension theory can thus to a certain extent withstand these accusations.

Overall however, I can admit that extension theory cannot account for all these effects in the way other philosophies and theories of technology can. Mediation theories (e.g. Ihde 1990 and Verbeek 2005) for instance contain a much wider vocabulary to conceptualize the relations between the human, technology and the world; sociological theories of technology (e.g. Pinch and Bijker 1984) can make us understand better how specific technological artefacts came into being; and for instance Latour's (1992) perspective can be used to develop a much deeper understanding of the way technology shapes and transforms human action. I believe however that admitting this does not undo extension theory from its value and relevance, for which I have two arguments:

My first argument is that while extension theory might not be as strong in these domains, it has important advantages of its own, which I believe are essential for understanding fundamental aspects of technology. What is namely possible to do with extension theory is to develop a basic understanding of technological artefacts over its evolution as to how they inherently and characteristically relate to the human and the world. More than other theories, extension theory allows us to analyze how artefacts came into existence, are used by the human, develop, generally shape and are shaped by the human and world, by analyzing specific artefacts' general characteristics. Uncovering the way these artefacts realize intentions - although this might not be the only function of a technology - is at the very least a very important aspect of a technology. Extension theory can help us understand and analyze whether these ways of realizing intentions have certain inherent effects, or for instance why and how a technology developed as it did. Instead of focusing on a particular phase of a technology (e.g. its historic development, existence, future design), extension theory provides the basis to understand the technology over the larger spectrum of this development and in that spectrum uncovers its characterizing features.

My second argument is then also that the basis extension theory provides can very conveniently be supplemented with other theories of technology. Analyzing the way technologies realize intentions does not for instance prohibit us from questioning these intentions themselves. Extension theory conveniently allows for further exploration of such dynamics, for instance by questioning whether the intentions that are realized by guns are necessarily good intentions to realize in themselves, or by analyzing whether the mere potentiality of health care technology to 'fix us' already implicates certain human behavior. In similar ways, other accusations, such as that we cannot account well enough for instance for effects that are described by Don Ihde's magnification-reduction notion, can be very satisfyingly solved by encompassing such theories within an extension understanding of technology. No philosophy of technology can necessarily encompass every aspect of technology – from its evolution, to its application, to its design and future use – in the greatest possible depth – concerning human existence, societal dynamics, ontological structure, environmental implications etcetera. Extension theory has to compromise on this dimension of depth, but compensates for this by being able to encompass additional theories and thereby is very valuable because it gives us a way to analyze on a general level how a technology came into being, the evolution of a technology and the way it affects the human in the way it can be used to realize intentions.

In this thesis I will indeed use extension theory in its greatest strength: to focus on the way the artefacts - information technologies - realize intentions, which sets of means they therefore extend, and thereby

how it came into being and was developed over time. This allows me to systematically develop an understanding of the characteristics of information technology on a general level. I will also indeed sometimes refer to other authors which can help to more deeply understand certain phenomena, especially as the fourth chapter will use a normative account to be able to explore the implications of the account of information technology developed with the extension theory as basis. In this way, as explained in the introduction, I fill a gap by developing a systematic understanding what information technology is and what its implications are for the human being.

Before doing that, there is one elaboration on the extension thesis that has been argued for, that makes it even stronger as a 'discovery tool' to characterize artefacts, which I will discuss in the next section.

2.4.3 Individual and collective extensions

After having formulated the extension thesis, Brey distinguishes between an artefact as an *individual extension* and as a *collective extension*. He says that a technological artefact cannot only extend a single human individual, but it can also extend further collective interests by being collectively used for a shared purpose. He gives the example of a house that is a collective extension as it protects its inhabitants. Thereby intentions concerning shelter and convenience are collectively realized. He adds that a collective extension can also exist when intentions are not shared by the individuals; a seat belt for instance helps the user by protecting him and also helps insurers by protecting them from financial loss, thereby serving as means to ends for these individuals simultaneously.

To be able to apply this idea of collective extensions for an understanding of information technology, I need to develop it. This is because it is not completely clear what is required to be individual or collective for these categories. Brey argues that artefacts that have functions for multiple individuals are collective, but this does not demarcate clearly what a collective extension comprises. Furthermore, there seem to be many different ways in which artefacts can be called individual and collective; people can for instance individually use a means to collectively realize an intention, collectively use a means to realize their own intentions, and every variation in between. To spell out these possible understandings of what a collective extension constitutes, I will establish a more detailed understanding of the difference between individual and collective extensions, which is valuable as a basis for the extension account in this thesis.

I will start with the observation that technologies cannot only be used by individuals to realize their own intentions, but that people can also use artefacts together to realize intentions of multiple people simultaneously. An interesting issue is that in certain conditions when intentions of multiple people correspond, we could call these 'collective' or 'shared' intentions. There are different ways to understand these conditions, Searle has for instance conceptualized these intentions as 'we-intentions'. When two people travel to Paris together, Searle's account calls it collective intention when each of them has the thought "We are going to Paris". There are many other accounts on what it exactly means to share intentions in this way, and for instance whether these intentions can be reduced to individual intentions (cf. Schweikard and Schmid 2013). For the account of extension of technology here, we are not interested in a very specific account of what shared intentionality is, as the aim is not to distinguish specific cases but to understand how a certain technology is used in general. Thus for now the important observation is that intentions can be personal and shared, which has consequences for the way

extensions realize intentions. Whereas a paper notebook for instance generally is used by only a single individual to realize his intentions, a whiteboard can be used to realize shared intentions, for instance for brainstorming or planning.

There is a further distinction possible, as there are different forms of groups. If for instance two people decide to go to Paris together, we can call this a shared intention. Now take an example of a business trip to Paris. Concerning the ones of the company who travel to Paris, we might again assume they intend to go to Paris together and realize certain intentions in that way. By going on the trip, they can however also realize intentions of other employees or other stakeholders. Raimo Tuomela (2007) calls this a 'we-group', which he distinguishes from a 'progroup'. In a progroup, individuals function as a private person in a group context. In a we-group, an individual functions as a group member for the group. In a we-group, the members have an explicit collective acceptance of, and collective commitment to, the group's goals; a distinction exists between operative and non-operative group members; and there are defined roles and positions. Tuomela indicates that such a group "is a collective artefact and indeed an organized institutional entity […]. Group members are viewed as functioning in group positions (be they differentiated or not)" (p. 20).

Although I think Tuomela's terminology is a little ambiguous concerning the words progroup and we-group, he does make an interesting distinction between (small) groups that are about private commitment and interests and organizations that concern explicit commitment and do not concern personal interests but interests as a collective. The observation that by means of an extension intentions could be realized that concern a specific group but also intentions that are of an 'organization' in general is interesting. Regarding Searle's concept of we-intentions, we can now thus understand that this 'we' might refer to a specific group of individuals, or to a larger more explicitly organized group. I will use this insight for the analysis in the next chapter and distinguish between the following levels of intentions that can be realized by an extension:

1. Individual: The realization of personal intentions of a single individual
2. Shared: The realization of shared intentions in a small group concerning individuals in a group context
3. Organizational: The realization of intentions of an organization concerning a group with explicit commitment and distinctive roles and positions

Some artefacts, for instance the car, can be used to realize intentions of each of these levels while another kind of artefact, for instance a bed, barbecue or butcher's knife, has more specific ways of use. Furthermore, the level of intentions that is realized is not per se related to the way an extension is used. People can use a means simultaneously to each realize their own intentions and an individual can use an artefact to realize intentions on an organizational level. When multiple individuals use a means simultaneously together, it can also vary whether their intentions actually coincide or are different as was already observed. While many individuals for instance will use the train to realize intentions concerning transportation, a homeless person might use it as a place to sleep. In such a case, the artefact is an extension of different sets of means for different individuals. For the traveler it could for instance be seen as an extension of the feet while for the homeless person it tends more to be an extension of

the skin concerning shelter and warmth. Also the other way around, for instance if a couple travels to Paris from separate locations, people might use different extensions to realize shared intentions.

Thus whereas Brey distinguishes between individual and collective extensions, there are many different ways extensions can be used by different configurations of people to realize different levels of corresponding or non-corresponding intentions. Instead of going into some multidimensional framework per artefact to uncover by who it is accessed, for which intentions on which level and whether these intentions correspond, I will here only note the distinctions that are practically useful for an analysis to provide additional information. This means that I will focus on the question on which level (i.e. individual, shared or organizational) intentions can be realized by means of the extension. I will also take into account whether a single individual, multiple or a group of individuals can access the means simultaneously in order to realize intentions.

By means of these two issues, we can analyze many different artefacts and understand how they relate or not relate individuals and groups with each other. While each artefact can in certain regards be used in all of these ways, an artefact generally provokes certain ways of use as an extension. A train is for instance generally used as an extension by different people to realize their private intentions, while a work bench in a company is used by an individual employee to realize organizational extensions. That an artefact can be an extension of different sets of means at once and that these can correspond or not correspond is also an interesting observation, but I will not link that to this distinction between individual and collective extensions; I will discuss that in the analysis when considering what it *is* that information technology extends, which I distinguish from *why* it extends as I will further clarify in the beginning of the third chapter.

To the extension account I have here thus added that there are many different ways in which artefacts can concern extensions for individuals and collectives of people and that uncovering these can give insights into the nature of artefacts. The most relevant distinctions concerning an analysis of an artefact in this way is the level on which intentions are realized and by whom the extension is accessed.

2.5 Conclusion

In this second chapter, I investigated the subfield of philosophy of technology that is concerned with extension theories of technology. Kapp and McLuhan, who wrote the two major classical works in extension theory, were discussed, as well as criticized to show what of their ideas is outdated and what is still valuable. I then turned to the contemporary state of extension theory and explored the different versions of extension theory that now exist. I thereby answered the main research question:

1.1 *What is extension theory and with which technologies are existing accounts of extension theory concerned?*

Then, I argued that the version of extension theory that evaluates technology as an extension of human faculties or capabilities is most relevant to further explore because it can give an understanding of what technology is and how it affects mankind.

From these discussions, Philip Brey's (2000) extension thesis proved to be a theory of technology that is most valuable in understanding technology from this perspective, because it provides a basis that can be further explored to come to an understanding of different kinds of technologies and artefacts. I adapted his thesis to be able to analyze not only how an artefact could extend the human natural means, but also the natural means of the environment, and discussed it in light of the critics of extension theory and defended it against their claims. Furthermore, I explored and further expanded his distinction between individual and collective extensions, distinguishing three levels on which intentions can be realized – individual, shared an organizational - and that some extensions can only be accessed by a single individual, while others allow more individuals to simultaneously realize intentions. In that way, I answered the second research question:

1.2 *What is a sophisticated and appropriate extension theory to investigate information technology?*

It is thus the adapted extension thesis - *"All artifacts extend a set of naturally given means by which human intentions are realized."* - that will provide a basis to understand the extension of information technology in the following chapter.

Chapter 3: An extension account of information technology

The computer in the modern sense of the word has been around for a couple of decades and in that time has rapidly become part of an enormous variety of (daily) practices, from banking to communication with friends and from gaming to work and studying. Of the American households, 84% now has a computer, 75% has an internet subscription and almost two-thirds has a smartphone (Pew Research Center 2015, United States Census Bureau 2014). The introduction of these new technologies into the many aspects of our lives requires us to think about the ways these affect us, what role these play in the life of the human and how we should evaluate that role.

In this chapter, I will develop such an understanding of information technology on a general level. This understanding can characterize information technology in what it is and does and how this relates to the human being. I will develop this account by means of the extension theory I established in the second chapter. There, I formulated an adapted version of Brey's (2000) extension thesis that provides a good basis for further elaboration. It is this extension theory that will serve here as basis for further investigation of technological artefacts, to answer the first question of this chapter:

2.1 *How can (different) information technologies be understood to be technological extensions?*

To answer this question, the history and evolution of information technology will be analyzed to uncover the kind(s) of extension these artefacts are. I start at the early punch card computers of the end of the 19th century and conclude with smartphone technology of today, and step by step see how information technology developed as an extension. I thereby distinguish the following major stages in information technology development: the first computers, advanced computers, the rise of the internet, and the integration of portable devices into our daily lives.

After this analysis, an interesting question is how the ways of extension that emerge from the analysis relate to those of earlier technological artefacts, which is the second sub question:

2.2 *Is the extension of information technology different from the extension of technologies from earlier technological phases?*

I therefore zoom out and bring this understanding of the extension of information technology into perspective by comparing it to the way artefacts from earlier technological phases extend the human being. It is in this way that I develop an understanding of the extension of information technology, both on itself, as well as in perspective to other kinds of technology.

3.1 The extension of information technology: The evolution of information technology

I will here consider how information technology extends the human being and how different information technological artefacts extend the human differently. I will therefore begin at the very genesis of information technology, and follow its developments as to understand the ways in which it extends the human organism. The adapted form of Brey's extension thesis serves as the basis for this chapter, as established in chapter 2. Let me therefore and for the sake of clarity recall this thesis once more: "All artifacts extend the set of naturally given means by which human intentions are realized."

By means of this thesis and additional literature, I will for every 'stage' of information technology first develop an understanding what it is that the information technology extends. This is however not the only relevant dimension. In the previous chapter I addressed how extensions can realize different levels of intentions and are accessed in different ways. This does not concern the question *what* or *how* it is extended, but *why* it is extended, which gives us additional interesting information about an extension. With this we could for instance understand that casual clothing mostly realizes intentions of the individual wearer, while a suit can also realize intentions on an organizational level concerning the company image; or that where a suit of a firefighter protects the individual to realize intentions on multiple levels, a firetruck extends multiple firefighters simultaneously. Taking this dimension into account can bring a further understanding of the role of information technology as an extension and how this affects the human being.

I distinguish these two 'extension dimensions' as the *ontological dimension* - what is it that is extended? – and the *teleological dimension* – to what level of intentions is it an extension? In the ontological dimension, I investigate the set of means that is extended and can thereby show how in different parts in the history of information technology, it became possible to extend different parts of the human being or the world. In the teleological dimension, I research why this extension has come into being: who uses the extension and whose intentions are realized by it.

3.1.1 Early computers: task-related dedicated information technology

A DOS-computer might today feel ancient, but the foundations of information technology – the set of tools, processes, methodologies and associated equipment employed to collect, process, and present information (Wadhwa and Harper 2015) - were actually established millennia before. The very earliest examples of these concern the abacus, or even the 22 million year old invention of the 'tally stick', a stick used to record numbers, quantities or messages. Interestingly, as I will further explain later, these earliest computational artefacts were also the earliest extensions by information technology. After a varied use of such primitive 'information technologies', developments from the 17th century onwards would lead to information technology as we know it today. After many theoretical developments and prototypical machines, in the end of the 19th century the development of the punch card (later punch band) computer meant the first distribution of computers under the 'modern definition': "a programmable electronic device that can process, store and retrieve data" (O'Regan 2012, p.23). Although these punch card computers were in performance nothing compared to today's, their ability to perform specific functions led in that time to a large increased efficiency of specific tasks. It allowed processes to be improved that relied on calculation and storage of data, which can predominantly be found in administrative tasks. For example, the 1890 United States Census could be completed in only a small fraction of the time compared to those of earlier decades (US Department of Commerce, 2015).

Today's computer hardware still owes much to these early steps of information technology. I will in this first 'stage' of information technology focus on a specific way computers were used from the punch card computer onwards and that is still an important application of information technology today: to run specific programs that are dedicated to specific functions or tasks. This is how information technology started and what still makes an important part of information technology use. A desktop at work is for instance still an important home base of many employees, running specific programs dedicated to their

profession. To name a few examples: weather forecasters, planners, secretaries and accountants. I will here research what it is these computers extend and then identify whose intentions are realized by such extension.

The ontological dimension: Early computers as a cognitive extension

Let us now consider what these early computers extend. These 'computers' - punch card computers, but the following applies to the abacus and tally stick as well - have clearly distinguishable functions to which they were dedicated. Generally these functions concern the processing and/or the storing of data. This started with very simply processes such as counting or summation and today it concerns far more specific and complex algorithms and storage rules. Whatever their complexity, the first step to understand these computers as extensions, is to observe that these two functions - processing and storing data - are also part of the human's 'natural given means'. With computers the human is thus able to extend these natural cognitive means technologically: they extend the set of means to realize intentions concerned with cognitive functions.

The tally stick was able to aid in these processes and thereby extended the means for calculation and memorization of data. Later computers extend these natural means further. It is with this way of extension that information technologies make it possible to achieve certain intentions within a much shorter timespan or in a much more detailed or reliable way. The human can also memorize, calculate and present data without an external artefact, but by extending these cognitive faculties with information technology, he can far excel these original abilities.

Early computers thus form an extension of a cognitive set of means. This idea, that certain cognitive functions can be distributed to external entities, has seen quite some exploration in the field of philosophy of the mind. Two major ideas relevant here are Donald Norman's (1993) conception of cognitive artefacts and Andy Clark's (2008) concept of extended cognition.

Donald Norman (1991) distinguished a special set of artefacts that "maintain, display, or operate upon information in order to serve a representational function" (p.17). This set which he called *cognitive artefacts* not only includes computers, but also includes thermometers, clocks and newspapers, which all focus on information and the representation of it. Information technologies make up a special set of these cognitive artefacts, as these are able to autonomously perform cognitive tasks and engage in relationships with the human user to together form a cognitive system (Brey, 2005).

Andy Clark (2008) focused on specific cognitive artefacts and argues that these have the potential to 'genuinely extend' the 'cognitively permeable human cognition' by technological 'tweaks' (p.40). By arguing this he goes further than just arguing that a cognitive artefact can extend the cognitive set of means, he actually argues that these technologies can become part of cognition itself. They can become "sufficiently well integrated into our problem-solving activity as to yield new agent-constituting wholes" (p.40).

This deeper conception of cognitive extension is not directly what is at stake here, mostly because it can be doubted whether the early forms of information technology provided cognitive help that was reliably available and easily accessible, which are among the criteria Clark mentions for such extension of

cognition is needed. Furthermore there has been much discussion and critique on what it means for artefacts to extend cognition, whether cognition is in itself not always already extended outside the human and to which extent external cognition is possible at all (Gallagher 2013, Allen-Hermanson 2012, Adams and Aizawa 2010). This discussion is however not relevant here, because, due to other interests and space constraints, here I am not concerned what precisely human cognition means and which specific role information technology can have in this cognition, but want to understand which extensions of sets of means characterize information technology. In that light, the important basis for understanding these early computers has been laid: as humans we "expand the relevant forms of storage and retrieval to include […] the data (and operations) made available by cognitive artifacts such as notebooks and laptops" (Clark, 2008, p.41). In that way, I believe it is clear that information technology extends the set of means concerned with cognition, as it clearly interacts with cognition, contributes to it and can even be used to 'off-load' parts of human cognition. I will explore the ideas of Clark (and the critique on these ideas) later in this thesis (section 3.1.4) but I believe we can now justify calling the way information technology - even when it as cognitive artefact is only used as kind of tool and not an embodied artefact - extends the set of cognitive means a *cognitive extension*.

The teleological dimension: Early computers as an extension to realize organizational intentions
Computers process and store data and by the extension thesis we can understand that they do this to realize certain intentions. These intentions obviously have to do with this manipulation of data, and generally concern specific intentions such as processing and storing accounting data or running certain algorithms to forecast the weather or stock market fluctuations. These intentions however are not always directly those of the individual user himself. Early computers were part of mainframes, which were generally in the possession of large business, research centers or other institutions. These institutions employed these mainframes to improve the efficiency of their workflow and although mainframes are not a large presence anymore of today's infrastructure, still many computers are used for professional purposes only. The intentions that are realized by such corporately (or institutionally) owned computers, then do not just concern the individual user, employee or scientist, but concern those of the larger organizations.

The 1890 census is an early but good example of how such an extension can be corporately integrated (U.S. Department of Commerce 2015): Late in the 19th century, hand counting had become too expensive and inaccurate for the large amounts of data to process. The original means of the employees to count and accumulate data had thus become too inefficient and ineffective. Therefore, these natural means were extended by early information technology: punch cards were used that completed a circuit for every count. Every time the circuit was completed, a dial went up. In this way, counting could be done much more efficiently and effectively, making the 1890 census to be completed far ahead of schedule and under budget. The employees who previously had to use their natural means to count were now cognitively extended and each had a machine that did the counting for them. However, these employees themselves had not chosen for this extension for their own intentions and it were not per se the intentions of the employees themselves that were realized. It were those of the census bureau. This bureau, more specifically the management, originally conceived intentions of efficiency and

effectiveness, and the employees by their role committed to these intentions. By performing tasks with the computer, employees thus realized intentions of the larger organization.

There are many cases in which information technology is used similar to the example of the census bureau. Not just the early forms, but also today's information technology forms an extension of certain natural means of the employees to realize intentions of the company or institution. Companies use all kinds of processing systems for instance, universities use planning systems, research teams use databases and project management systems and municipalities use online work processes. Additionally, often an intranet connects employees to assure company-wide intentions are met.

This use of information technology – where it extends certain individuals and thereby realizes intentions of a larger organization of people – was thus an extension to realize what was in the second chapter introduced as intentions on an *organizational* level and also today's practices concerning professional use of information technology can be classified as such.

Conclusion

To summarize, early forms of information technology were able to form an extension that allows the performance of certain data-related tasks much more effective and efficiently than with the original means. To do that, the natural cognitive set of means of users of information technologies are extended. These extensions often serve to realize intentions of a larger organization of people. In this way, early forms of information technology, and similar applications of information technology today on the work floor, form a cognitive extension of the natural set of means of the individual to realize intentions at an organizational level.

3.1.2 Advanced computers: simulation as material extension

The organizational extension of information technology improved the performance of many companies and other institutions. As the computer became more widespread, it also started to receive the interest of individual enthusiasts. In the 1970s, a group of computer hobbyists started to emerge, which appropriated the computer for their own use. This led to the development of computers that were not just intended for use in organizations, but also for use by the individual at home. The Altair 8080 was the first successful *home computer* in 1975 (O'Regan 2012). These early home computers were originally mainly used for programming and early video games, but would soon encompass more functions related to the personal computer of today. In this new role - from the work floor to the home of the user and from corporate use to leisure applications – information technology emerged as new kind of extension that I will further explicate here.

The ontological dimension: Advanced computers as a material extension

Home computers have the ability to extend the same cognitive faculties as the early computers that were discussed before. With the personal computer, also a new kind of extension started to emerge. The most important development for this extension was that more internal storage capacity was becoming available, which meant computers no longer had to focus on only extremely efficient use of memory. This had until then led to reducing functions to their fundamental basics, i.e. the extension of cognitive faculties of the early computers. As information technology progressed however, more space became available to not only focus on function, but also on form. In the 1980s this led to the first 'graphical user

interfaces' (GUIs). Apple launched their Apple Lisa in 1983, which was the first personal computer to use a GUI: files looked like actual pieces of paper, the trash folder like a trashcan and the calculator, notepad and alarm clock were all displayed graphically.

This step towards graphical interfaces and representation of applications was a relevant one, because it was a step away from the pure cognitive extension information technologies initially provided and towards mimicking the physical world. With space available for form and design, the 'simulation function' of information technology emerged (Brey 2005, Turkle 1995). This simulation function concerns a different function - and can extend different sets of means - than the cognitive extension of early computers. It concerns the extension of a *material* entity by means of a graphical representation. To show this distinction and that new sets of means could be extended in this way let me provide an example:

The cognitive extension of information technology provides the ability to store data. This is an extension of the set of means to realize intentions concerning memorization. Accordingly, the alternative means within mentioned *set* are thus predominantly formed by faculties of the human being himself, more precisely the memory region of the brain. It follows that the relevant set of means in this cognitive extension is composed of mental faculties, which are extended.

The simulation function of information technologies is different because it does not just relate to a cognitive faculty, but to an external entity. The possibility to make a computer drawing for instance simulates the physical pencil and canvas and thereby is not just a cognitive extension, but an extension of the material means themselves. The set of means that is extended thus concerns material objects and not (only) mental faculties. The means to realize the intentions to which the computer forms an alternative are not just within the brain, but in the outer world. It is in this role that information technology extends not only human faculties, but extends external entities.

As I already introduced shortly in the second chapter, this is quite a revolutionary observation concerning the understanding of how technology can be an extension. The idea that technology can extend the human's natural means, those of the body and the mind, can already be found in the very first extension theories. That technology could also extend material means of the world by mimicking them is however new and has not gained as much attention. Technology can form an alternative to *both* the bodily means of the 'naked' human and to the natural environment that is manipulated, in order to realize intentions. I will later in this section turn to the question to which extent these two kinds of extension can be completely distinguished from each other but will now first further clarify how to understand this aspect of information technology that Sherry Turkle (1995) identified as the simulation function and Brey (2005) formulated as the difference between epistemic functions and ontic functions.

We have gained some understanding of the way information technology can mimic the external world in order to realize intentions and it is worthwhile to further investigate this new way of extension, starting with the concept of 'simulation'. This term requires some further clarification, as there are different ways to conceptualize what simulation means. It can for instance concern a mathematical model or another system to investigate certain affects (Winsberg 2015). It is clear that here we are concerned with

simulation in a broader sense, the idea of "[s]imulation [as] the imitation of the operation of a real-world process or system over time" (Banks 2000), but this does require some further explanation.

In order to get a more concrete idea what it means that information technology is a 'simulator', let me first compare the broader simulation function of the computer to simulation in the more narrow sense. As example of a computer simulation in the narrow sense I use hospital layout simulator. As example of the simulation function of information technology I take the word processor (such as Microsoft Word), which simulates pen and paper:

Both the word processor and the hospital simulate a real-world object or process. Both imitate the functionings that are naturally available to us and alter them in specific ways. The important difference I think is in the *effect* of the simulation: The effect of the simulated hospital is part of the simulation. It is not 'real' in the sense of an actual hospital is: no one is cured in a simulated hospital. The effect of the pen and paper simulator however is just as real as the thing it simulates. That is, a book that is written on a computer only has to be printed to make it just as real as a physical book. The printer 'translates' it directly to the physical world, which is impossible for the hospital model kind of simulation.

It is this realness of the effect that makes it possible for information technology to become a substitute of the thing it simulates. A music player that has speakers connected to it as physical 'translator' has an effect just as real as a record player, and a drawing that is printed is as real as its easel counterpart. In fact, it is only *because of this real effect* that it is possible for the simulation of information technology to realize intentions in the first place, to become an extension of that set of means. Were the effect not real, the intention concerned with the original object could not be realized by it.

This discussion of simulated environments and real effects touches discussions of what we mean with the word 'real', especially in virtual worlds (Mooradian 2006). Philosopher J.L. Austin (1962) has conceptualized a problem of 'realness' that altogether is interesting in this regard:

> "But whereas we can just say of something "This is pink," we can't just say of something "This is real." And it is not very difficult to say why. We can perfectly well say of something that it is pink without knowing, without any reference to what it is. But not so with 'real' for one and the same object may be both a real x and not a real y; an object looking rather like a duck may be a real decoy duck (not just a toy) but not a real duck. When it isn't a real duck but a hallucination, it may still be a real hallucination as opposed, for instance, to a passing quirk of a vivid imagination. That is, we must have answer to the question "A real what?" if the question "Real or not?" is to have a definite sense ..." (p.69)

To go much further into this philosophical discussion what real means in a virtual world is not within the scope of this thesis. The question "A real what?" is however relevant concerning the argument that the simulation of information technology can have a 'real' effect. I think we can understand this realness quite clearly in the context of the account of extension theory that is developed. We can then namely understand that for something to have a *real* effect, it must be a *real extension* of a set of means, in other words, it must be able to realize the same intentions. The question "A real what?" can in this context thus be answered as "A real extension to realize real intentions". This has consequences for the

understanding of what an extension is in general: something can only be an extension of a set of means when it indeed can realize the intentions where that set of means is generally used for.

With this reasoning we can understand that while a word processor can be an extension of pen and paper, as its effect is real, a virtual flight simulator is not a real extension of an airplane, as we cannot realize intentions concerned with travel. That does however not mean its effect is altogether not 'real'. Such virtual flight simulator can be a real extension of a set with other means that mimic airplane behavior, such as the pre-computer set-ups that used pumps, valves and bellows to create flight simulators in the early 20th century (Roberson Museum and Science Center 2000). It then has a real effect concerning the simulation of airplane behavior. Thus to understand to what a simulation is an extension, we have to ask to which sets of means it forms a real alternative, an extension to realize intentions.

To summarize, with the advancements concerning computer memory and processing capacity information technology acquired the ability to simulate physical entities: Information technologies can mimic parts of the world to extend sets of means and to realize intentions in the way these means can be manipulated. I will call this simulation function of physical entities the *material extension*.

A question that emerges from the now made distinction between the cognitive extension and material extension of information technology, is to which extent these two can really be separated, can be seen as two completely different kinds of extension; one concerning innate functions, the other concerning external objects.

An initial objection against a hard distinction between these two extensions is that cognition is always involved in the realization of intentions. While a word processor can be considered an extension of pen and paper, only by means of the cognitive abilities of the user can the actual intention be realized. There is clearly an interaction between cognition and information technology in order to realize the intention, also when it involves an extension of a material object.

There is another consideration: Following what I now conceptualized on material extension, a virtual pen and paper are clearly an extension of physical pen and paper. This however entails that the virtual pen and paper are also extensions of the sets of means that were extended by the original physical pen and paper. Because material pen and paper for instance extend sets of means concerned with communication or creativity, virtual pen and paper also extend these means. Similar, a simulated calculator materially extends both the calculator artefact as does it extend the cognitive faculties originally extended by that material calculator. Material extension thus does not only extend material objects but can also be understood as an extension of the faculties originally extended by that object.

Interestingly, the way the material extension mimics the outside worlds, seems to contribute to make these virtual means more appealing, because the user can recognize the sets of means he is naturally familiar with to realize the intention. The data storage in a GUI for instance mimics a file folder and a blank page on a word processor looks like an actual sheet of paper, in order to directly relate the application to its real world counterparts. This facilitates the realization of intentions, which are ultimately related to functions that are realized by cognitive extension.

The above shows that there is no dichotomy between the cognitive and material extension of information technology. This does not mean that they cannot be distinguished however: Information technology as material extension simulates a material object, thereby extends it and in addition also extends the sets of means that the original object extends; information technology as a cognitive extension does not refer to a material object but extends cognition itself. Being able to distinct these two ways of extension and understanding that most applications are combinations of them by simulating a material entity and thereby facilitating the extension of a cognitive faculty, is valuable as it will help us understand what information technology is and does and how it relates the human to the outside world.

The teleological dimension: Advanced computers as an extension to realize individual intentions
Home computers were able to extend new sets of means to provide alternatives to material objects, concerning for instance writing, painting or entertainment. Another important shift with home computers was that the intentions that were realized in this way now started to be separated from organizations and could actually concern the individual's own intentions. Computers started to be appropriated in the homes of the user and were now deployed to realize intentions of the individual user himself, to play video-games, run family-specific scripts or for hobby-programmers for example (Shamberg 1970). Thus while both a company-owned mainframe and a personal home computer can extend the memory of the user, the use of the former realizes intentions of the company, while with the latter the user can realize his personal intentions. By stepping away from a hierarchical use of information technology, home computers allowed information technology to become an *individual extension*.

As explained in the second chapter, this possibility for individual extension does not mean that every use of such home computer was an individual one; friends could for instance play a game on it together thereby using as a shared extension and Shamberg (1970) provides an example of a whole family benefitting from one of its members making a program to determine their dinner plans. The important step that was made however, is that the computer now could realistically form an extension to realize individual intentions whereas in earlier setups that was impossible.

Conclusion
Advanced computers were an important step for the extension account of information technology as these did not only focus on cognitive faculties anymore, but started to provide simulations of material objects. Because these simulations have a 'real' effect, they would form extension of those sets of means and could be used to realize intentions concerning them, such as writing and drawing. Furthermore, these computers enabled a step away from the extension of organizational intentions and began to be used to realize intentions of individual human beings.

3.1.3 World Wide Web: the rise of an interconnected network of users and artefacts
After becoming a platform that could extend cognitive faculties and physical entities into a digital realm, progressing infrastructure provided a new step in the extending function of information technology: the internet. The initial use of the computer was mainly an individual one or on an organization level. The internet changed this, by interconnecting computers which entailed new ways of extension. I will here

first discuss what new sets of means could be extended and then turn to the kinds of extensions that emerged throughout the development of the internet.

The ontological dimension: The internet as an extension of objects, locations and interaction

Today, the World Wide Web contains close to a billion websites which about halve of the planet's population uses to realize a large variety of intentions (Internet Live Stats 2015). These concern for instance entertainment – think of Netflix and YouTube –, information – Google, Wikipedia and BBC -, communication - Facebook and Windows Live - and trading - Amazon and Tmall (Alexa 2015). All of these websites have millions of daily users, and millions of other websites contribute to making the internet an enormous step in the history of information technology. Is the internet then also a new form of extension?

While the previous applications of information technology were used in more or less uniform ways, getting a grip on the internet is much more complicated. It is a medium that is always in flux due to its nature of both mass and individual communication and use and its constant developments. It is also a very heterogeneous medium where intentions of all kinds are realized and where the only elements all the applications have in common, is that they somehow connect individuals to a server, where they can get involved with each other, or with information that is stored there.

To develop an extension account of the World Wide Web, let me first question how it compares to the earlier extensions of information technology. To start, it is quite clear that the internet is at least not 'just' a cognitive extension. It does not provide an extension of a set of means that is only related to our natural cognitive capabilities. Is the internet then a kind of simulation? There are clear resemblances between processes in the world and those that the internet provides and I will therefore investigate this line further.

The online 'cyberspace' provides many means to realize many different intentions. The processes to realize these often resemble the set of means that is extended: online trading is similar to real-life trading, e-mail mimics physical mail, online news websites are like newspapers, and the list goes on. In accordance with what was discussed in the previous section on simulation, also here the effect is real: when one for instance talks to another person via the internet, the process of a messenger is simulated, but the actual message is received just as well as the 'outer world' counterpart.

As said, the internet is enormous in its possibilities. Let me therefore make a division of its functions and how it can be understood as an extension. To make this division, I listed the most often used online sites or services and classified the sets of means they extend. This overview can be found in figure 1. In large font is displayed what the online possibility is, while in smaller text is depicted what is simulated: what sets of means it forms an extension to in order to realize intentions. As can be seen, from this overview emerged three categories of sets of means that are extended:

First, the internet contributes to the ability of information technology to simulate physical objects. Due to the internet, not only applications such as pen and paper can be simulated, but now also media that involve other people or updates. Newspaper, television, music, games, maps, all can be extended digitally. By means of the internet, these digital objects can always stay up to date, to provide the latest

news and media. They become available when we want, where we want and thereby overcome the physical constraints the physical object normally have.

Second, the internet adds the possibility for the user to interact with others by means of information technology. Calling, chatting, spreading personal news and debating can all take place via the digital medium instead of in person. The *effect* again is real – the message in an e-mail is for instance just as real of effect as a physical letter is – but the *process* – sending a letter or telegram, or calling someone - is simulated. Thus human interaction is extended online.

Third, in addition to the possibilities to simulate objects and interaction, a possibility to extend locations is added. Via the internet, physical locations can be simulated and thereby specific ways of interaction with other people or objects can be provoked. In the case of digital stores, banks and class rooms, a location is simulated in a quite literal sense, while social media more indirectly resemble village squares or pubs. Whereas those original locations are located in a specific space, the internet makes them independent of it. It makes it possible for the user to realize intentions from his office chair for which he before would have to go to specific locations.

Figure 1: A classification of the extensions that have come into being with the development of the internet

The above three elements – objects (that can be updated), locations and interaction - are extended together and at once. Most of the applications of the internet are some kind of combination of these capacities to create a specific experience or service. Online banking is for instance a combination of human interaction in a simulated bank; browsing through books concern physical simulations of books in a simulated library; sharing photos with someone concerns human interaction and photos as objects and a classroom can be simulated, where both the teacher and the students have and receive a real 'effect', only the medium in between is simulated.

By means of this reasoning, I want to make one more step. We have seen that information technology has gained the capacity to simulate locations, objects and human interaction. An interesting question now is: What more is there in the world? From the human perspective at least, every activity seems to involve these three elements: the world around us consists of places where people do things with things. It is in that way that the internet becomes a world in itself, as extension of the set of means of the physical world. The world of the internet might be limited – it cannot perform simulations that produce the effects of animals, plants or chemistry for instance –, but the activities it does simulate, it often does very naturally. Chatting, shopping, updating social media, reading blogs, all provide often-used extensions to physical means to realize intentions. And the 'cyberspace' is which these are simulated in that way starts to become a world on itself, a digital extension of the physical world.

Interestingly, in this digital world, we can also distinguish other 'real world' processes emerging. Money for instance has been digitalized and thereby extended, and one can break laws, have a specific role ('moderator' for instance), own property and even attend weddings online (Locker 2015). So by means of the affordances of the internet, also parts of what Searle (1995) calls our *social reality* can become part of the online reality. Entities are extended that have functions which are confined to a physical structure, but dependent on the *status functions* they embody, the role they have. Their extension has come into being by means of the possibilities created by the possibilities of the internet. It is due to people having the ability to interact with each other and with simulated entities and the subsequent recognition of certain status functions, that the extension (or ontological reproduction cf. Brey 2003) of these social facts has become a possibility.

There are thus many possibilities in the online world that the internet has enabled. Virtually any website or service online can then also be understood with the above representation of an extension of a real world entity or interaction. There is however one online service I have not discussed so far, which actually is the most visited website in the world: Google Search. The search function (of Google and its competitors) has for many emerged to be the logical place to start an internet activity. While all internet activities before could be understood as simulations of real life situations, the search function does not directly allow such a translation. It has elements in common with the world's infrastructure and signage, but it is so much quicker and more efficient, that only if teleportation existed, the 'outer world' would seem to have a counterpart. This is general the case with 'transportation' between different locations online. Everything online is virtually instantly accessible from every internet location. Even if the physical servers are located on different sides of the world, this will merely result in a negligible time delay. Distance in space seems to have no role in the virtual world of the internet and this might be the most significant difference between most real-world processes and information technological extensions.

In summary of the ontological dimension, we can thus understand the internet to extend many new means of the world, in the way it simulates objects and allows them to be continuously updated, and extends locations and human interaction. A note to mention here is that it can of course be debated what it exactly is that is simulated. Does a chat program for instance simulate a real-life conversation, a human 'messenger', a text message or a telegram? For each of these options there are arguments, but interestingly for understanding it as an extension this is not a relevant question. This is because each of these alternative processes can be contained in the *set* of means that is extended. Thus while information technology does not precisely extend a single one of these processes, their way to realize intentions can be simulated by means of the internet, in order to extend the combined set of means.

In this way, many (sets of) processes in the world can now be extended by information technology in order to realize intentions. The internet's search function adds to this functionality, which is an extremely efficient extension of the material infrastructure. The internet thus mimics the real world and thereby is an extension to it, but it does so with its own set of rules. Everything is directly accessible and easily searchable and the world is shared not only with those around you but with the whole population.

The teleological dimension: The internet enabling the realization of shared intentions

I argued that by means of the internet, information technologies are able to provide many new extensions. I will here show that also in the teleological dimension, the internet is an advancement when compared to the earlier capabilities of information technology. To show this, it is interesting to shortly consider the history of how the internet of today came to being:

The first steps towards the internet were made in the 1950s and 1960s, when the 'ARPANET' project was launched, an initiative of the United States Department of Defense (O'Regan 2012). In 1965, the first wide-area connection was made in that project, from a computer at MIT to a computer in Santa Monica. A decade later, more than thirty institutions were connected, including research organizations, universities and government organizations such as NASA. Many other institutions had meanwhile developed their own (non-compatible) networks in order to also reap the benefits of a networked workspace (Leiner, et al. 2012). Later also commercial companies started their own networks, or connected to the expanding network called "ANSNET" (Advanced Network Services).

The early form of the internet was thus developed to connect research institutions and commercial companies, and these could communicate in order to expand their knowledge and collaboration. In this early form, the internet clearly formed an extension to realize intentions on an organizational level, as it was intended to benefit the goals of the organization which implemented the network.

With the development of the first home computers in the late 1970s and 1980s, also experiments had started connecting individual users. E-mail had then been developed, and this also led to the 'usenet' for instance, a distributed discussion system where users can read and post messaged in newsgroups. At CERN the first developments concerning what would be the 'World Wide Web', had then also begun. This network was initially used as an extension to realize organizational intentions to be able to keep track of all the employees, computers and documents. Later, in the 1991, CERN announced its World Wide Web to the public, which was in 1995 completely opened to commercial companies, after which

many jumped in to this promising new development with expectations as high as that brick-and-mortar companies would soon all be replaced.

While organizational intentions had thus been the most important drivers for the development of the internet, it now also started to be welcomed by the individual computer users. Early adopters had already been involved with the internet for a decade by then, and as a larger public entered the internet, they could find and interact with information, make use of companies, or upload blog posts for instance. With these developments, the internet now provided also a means for individuals to realize their personal intentions from their homes.

Possibilities for communication had simultaneously evolved. Next to e-mail and usenet, also chatrooms and "Multi-User Dungeons" (text-based virtual online worlds) emerged (Sloan 2006). With the World Wide Web, this was followed by many other online ways in which individuals could interact with each other online and communicate, collaborate and together make use of more internet services. Users could now access the internet together by means of their private computers and by interacting could realize their intentions together. This is a significant step, as it allowed individuals to collectively realize their intentions, accessing the same medium but from different locations. A group of friends could for instance together realize their 'we-intentions' to create a level for a game, or a couple could by means of direct communication watch a movie together. In these ways, it became possible to realize *shared* intentions, simultaneously accessing the same medium but from different locations. The telegraph and telephone could be said to have been the first media to enable the realization of shared intentions on a distance and by means of the internet, information technology now added many functionalities concerning the content of the shared intentions that could be realized.

The internet thus added the possibility to realize shared intentions and individual intentions simultaneously and thereby now information technology had incorporated functionality to realize intentions on each level and by means of simultaneous interaction or by individual interaction with the information on a server. These insights add to what I established in the discussion of the ontological dimension of the internet; that the internet has become a kind of extension of the world, in which indeed all kinds of intentions can be realized.

Conclusion

Both concerning the ontological and the teleological dimension, the internet provided an important advancement. First, the interconnection of individual users of information technology enabled the simulation of updated media such as newspapers, of locations such as the classroom, and of human interaction. In this way, many new sets of means could be extended in order to realize intentions that could before not be realized with information technology. So many different kinds of intentions can now be realized, concerning objects, locations and interaction, that we might speak of an extension of the world itself, where the search function serves as an extremely efficient infrastructure. Second, the internet enables the realization of shared intentions together and has turned information technology into a technology that can be used to realize intentions on each of the distinguished levels, with a possibility for simultaneous access to the same extension from different locations.

3.1.4 Smartphones and other handheld devices: the portability and ubiquity of information technology

The time that the average Western household had one computer that was used by all members has been long gone and almost every member now has at least one information technological device he or she can call his own. Especially the end of the first decade of the 21st century meant a rapid development for the advanced portable computer, with the introduction of the smartphone, tablet and more widespread use of the laptop. These devices allow users to carry the functions of information technology with them always and everywhere they go. There are many devices that now are part of this significant step of information technology, which vary from an unwieldy desktop computer to an easily portable smartphone device. Because it seems to be the ultimate contemporary example of portable information technology, I will take the smartphone as premier example.

There are many different intentions projected to a smartphone, concerning communication, information and entertainment for instance and the means to realize these intentions are all confined within the small rectangle we call our phone. The extensions that are formed in this way are of a varying nature. The versatility of the smartphone enables both cognitive extensions, for instance by extending memory with note applications and calculative abilities with complex graphical computation applications, and material extensions by for instance mimicking a music player or television. Both cognitive and material extensions are possible because of the incorporation of all previous aspects of information technology into this one artefact.

A smartphone may thus concern the same intentions as earlier forms of information technology, but it realizes these in a way that needs further exploration. An important difference with earlier IT namely lies in the fact that the smartphone is generally much easier accessible and available in much more situations, mostly due to its portability and ease of use. Because of this, smartphone owners use their device much more often in more different situations, and with a higher dependency. The average user of a smartphone accesses it nine times per hour (Meeker and Wu 2013), for many different tasks and situations. This continuous usage and growing dependency turns portable information technology into a new stage of extension, as I will explore here.

The ontological dimension: Portable information technology as an extension of the mind

As said the smartphone realizes intentions by both cognitive and material extension. Let me start by exploring the cognitive extension. As argued in section 3.1.1, early computers could already extend cognitive faculties such as calculation and memorization. In performance and function these resemble the actual mental faculties. However, in accessibility and availability, these desktops do not match their brain counterparts. When one for instance wants to calculate the total price of something when in the supermarket, or memorize a specific appointment made in a pub, one cannot depend on his desktop and has to resort to the 'original means' of the brain again. With the smartphone, the situation is different, because it cannot only match the actual brain in function and performance, but also in accessibility and reliable availability. This is relevant, as thereby the smartphone makes an extra step as cognitive extension.

This extra step is the one I already shortly mentioned in the section on cognitive extension (3.1.1): it is the one Andy Clark (2008) makes when conceptualizing that cognitive processes genuinely extend into the world. This idea has been further developed as to say that certain external entities have the ability to *extend the mind* itself. This concept of the extended mind was formulated by Andy Clark in co-authorship with David Chalmers in 1998. I will here introduce their 'extended mind thesis', which fits greatly with the extension thesis, as it brings a further understanding of how information technology starts to become an even more important extension.

The basis of Clark and Chalmers's extended mind thesis, which has been named the *parity principle*, is:

> "If, as we confront some task, a part of the world functions as a process which, were it done in the head, we would have no hesitation in recognizing as part of the cognitive process, then that part of the world is (so we claim) part of the cognitive process." (p.3)

In performing that task as 'extended mind', the human organism is linked with an external entity, which creates a *coupled system*:

> "If we remove the external component the system's behavioral competence will drop, just as it would if we removed part of its brain. Our thesis is that this sort of coupled process counts equally well as a cognitive process, whether or not it is wholly in the head." (p.2)

Not only cognitive processes extend to the external world, also mental states - especially *beliefs*, where Clark and Chalmers focus on - are argued to be extended. They give the example of a person with Alzheimer who for every action consults a notebook. We can say that the book's contents can store his beliefs just as a mind could and we can understand the person and book as a coupled system of biological organism and external resource. This reasoning makes Clark and Chalmers to argue that "the mind truly extends into the world" (p.5).

However, not every artefact that has some (causal) relation to mental processes should be considered an extension of the mind. Some reliable coupling is required. Clark and Chalmers extract the potential criteria for an extension of the mind from the actual characteristics of the human 'internal mind', which can sometimes decouple, malfunction or have a loss of capacities, in states such as sleep, emotion or intoxication. From this, they reason that if the relevant capacities of an external entity are always there if the user needs them, then the coupling is reliable enough to regard it as a possible extension of the mind. They propose crucial features that play a role in the extension of the mind with external entities: easy accessibility, reliable availability and automatic endorsement.

Clark and Chalmers argue that by means of these 'crucial' features we can distinguish that some artefacts have the potential to store beliefs and thus extend the mind, while others do not. My argument now is that a smartphone could satisfy these three features formulated by Clark and Chalmers, while earlier forms of information technology could not. Early computers already had the ability to store memories. However, such device is in general not consistently easily accessible - it first has to be booted and logged-in to - or reliably available - a desktop is generally fixed to a certain room - which makes it an extension of specific cognitive means to realize intentions, but not an extension of the mind. A

smartphone on the other hand seems to be just as easily accessible, reliable availability and subject to automatic endorsement as a paper notebook (which Clark and Chalmers consider as a possible extension of the mind) if not more. Today's possibilities of 'cloud storage' (the online storage and access of personal data) make personal information such as one's preferences, agenda, task lists and projects one is working on even more ubiquitously available to the user. This enables the continuous 'carrying' of one's digital self and a further integration of information technology in daily activities. Thus while to earlier information technology memorizing data could be 'off-loaded' by means of cognitive extension, the portable generation can actually store beliefs and couple with cognition with characteristics similar enough to the human mind. This way of extending the sets of means of the mind itself to realize intentions, instead of only specific cognitive processes, can thus be considered as extension of the mind.

I thus believe that the characteristics of the smartphone satisfy the features Clark and Chalmers describe and therefore can be considered an extension of the mind within their thesis. Also without this additional insight we could have arrived at this conclusion, because by its portability a smartphone is able to *extend sets of means* related to the mind more than only specific cognitive faculties, in order to realize intentions. The additional conceptualization is interesting however because it takes a step further than only this claim of extension of a set of means; Clark and Chalmers actually claim that ultimately there is no relevant difference between, say, a device that is implemented within the brain and a smartphone, if they have the same features. By saying that external entities can 'truly' extend the mind, Clark and Chalmers tend much more to an ontological claim. I do not per se aim to make such an ontological claim here about the role of information technology in cognition and mind processes, but to show that incorporating these views is a possible additional way of taking the extension thesis one step further. Within this framework the smartphone can namely be granted a different status than earlier information technology, which sheds additional light on the significance of portability of information technology. It should however also be considered that Clark and Chalmers have encountered lively discussion and criticism on their extended mind thesis. Some of these critiques resemble general arguments against extension theory, as discussed in section 2.4.2. Not all critiques are per se relevant for my thesis as my aim is different than that of Clark and Chalmers as I now explained. It is also certainly not possible here to do complete justice to - or even solve - all discussions concerning the (im)possibility and (in)appropriateness of the concept of the extended mind that have been around for almost two decades now, however it is still interesting, also for the sake of completeness, to shortly consider a few of these critiques and their implications for my claim that the smartphone can extend the mind:

Adams and Aizawa (2010) have criticized Clark and Chalmers because they believe the authors commit an instance of the 'coupling-constitution fallacy'. This is the fallacy of jumping from the observation that an object is coupled with a cognitive agent to the conclusion that it is constitutive of cognitive processes. It is indeed not a given that if something is coupled to our mind, this also makes it constitutive of what is going on (as they say: "'Why did the pencil think that 2 + 2 = 4?' 'Because it was coupled to the mathematician.'" (p.1)). I believe Clark (2005) has however convincingly argued that he never had the intention to argue that "just any old kind of coupling" (p.5) is an extension of the mind. Also, he is not concerned with the question when something is itself cognitive, but the question when it is part of a larger cognitive routine. In this context, it was exactly with the goal to distinguish relevant constitution

from mere coupling that Clark and Chalmers originally formulated "the conditions of (broadly speaking) 'glue and trust' [i.e. the three features discussed above]" by which we can determine whether an artefact "play[s] the kind of role that itself ensures its status as part of the agent's cognitive routines" (p.5). Thus while indeed not every artefact that has some coupling with cognition is part of the extended mind, the three features the authors proposed can help us distinguish the artefacts that do. As I showed, even a quite strict understanding of these features point us to the conclusion that the smartphone can actually be a major part of the user's mental routines.

Aydin (2013) criticizes Clark and Chalmers (and other authors within this field) to wrongly assume some 'original inside'. He proposes that we should rather speak of the 'Artifactual Mind', which acknowledges that external objects and artifacts continuously shape the "very fabric of our think" (p.2). I believe Aydin's claim is justified; that the idea of the mind as a living inside which can subsequently use the external 'dead matter' of objects and artifacts is indeed flawed. Further going into the depth of this issue leads us to an ontological tangent of what the mind ultimately is, for which I do not have the space and which is out of the scope of this thesis. Interestingly however, I believe that within this idea of the Artifactual Mind, it can still be possible to grant certain artefacts different functional statuses than others. I would namely argue that while indeed the mind itself is always already the product of its environment, we could distinguish the role of (for instance) the smartphone - which can actively and consistently contribute to and participate in processes in order to realize intentions – from a snowstorm or spoon which cannot.

Gallagher (2013) has criticized the three criteria of Clark and Chalmers. He does this because these criteria seem to be derived from an understanding of the mind as being constituted by beliefs, desires, and other propositional attitudes, which is actually the understanding of the mind that the extended mind thesis challenges. This wrong basis makes the criteria too conservative and 'wrong-headed'. I again do not have the room to further elaborate on this, but it is interesting that as alternative he proposes that things can be seen as extension of the mind if they create a coupled system that could be understood as a cognitive system in its own right and "without [which] such cognitive processes would no longer exist" (p.4). For him, this also includes for instance legal systems. As we can now see, Gallagher's critique does not limit us to see the smartphone as an extension of the mind because such device can be an enabler and constituter of mental processes: When our smartphone reminds us of an appointment, when we browse through our notes or when we quickly calculate the bill share of each of the dinner participants, it is clear information technology has become an extension of the mind's sets of means; even if we are not concerned with the three criteria but rather consider the smartphone to have an enabling and constituting role in these processes.

These critiques are thus valuable for the ontological discussion but as I have now shown, do not make it unjustified to argue that the smartphone is an extension of the mind within the context of this thesis, even if the extended mind thesis on itself is not per se valuable or sophisticated enough. The insight it provides us with, is that the ability of these information technological artefacts to extend the set of means of the mind in order to realize intentions distinguishes them from most other artefacts in general, also if we believe these also contribute to cognitive processes and should even be considered to be part of - or shape - the mind.

The smartphone and other portable information technology can thus be considered an important development, as it becomes a digital carrier of cognition, beliefs, and ultimately the mind. This idea of the smartphone technology as extending the mind to realize intentions, or at least having the potential to extend the mind, is especially interesting because the smartphone has not just the potential to be some digital notebook only storing beliefs that have been previously written by the user; there is also access to a much larger database of memories and beliefs; the online web. The smartphone is thus not just a digital notebook, but it can also make the World Wide Web become an extension of the mind through its direct accessibility and reliable availability, for which the portability criterion is the most important.

Clark and Chalmers in their original paper from 1998 already considered the (im)possibility of the internet as extension of the mind: "The Internet is likely to fail on multiple counts, unless I am *unusually* computer-reliant, facile with the technology, and trusting, but information in certain files on my computer may qualify" (p.38, emphasis added). Seventeen years after original writing, we can however perceive this statement a little different. What was considered 'unusual' concerning computer dependency in 1998, seems to be becoming usual with current information technology. Many of the users of a smartphone very easily and naturally operate it and have become trusting and reliant of its contents. In having a general conversation, watching a movie, or visiting cities, or simply when any question pops up in the mind, within seconds one has found facts and opinions about all of it. Especially Wikipedia, in combination with Google's ever improving search algorithms, has dramatically improved the accessibility and convenience of online information. In extending the minds, these functions form an extension that is often relied on to realize intentions with contemporary information technology.

In conclusion to the above, although the concept of extension of the mind can be disputed concerning its ontological implications, we have understood that by its coupling the smartphone 'at least' forms an extension of the sets of means of the mind. This significant development is made possible because these portable information technologies are the first that are generally easily accessible and reliably available. This also has the implication that its features concerning internet access can contribute to this extension.

Also concerning material extension we can see a development with the arrival of conveniently portable information technology. One of the main developments of becoming portable is that information technology now allows the user to access the internet always and everywhere, making its contents and the extensions it provides even more ubiquitously accessible. Especially the simulation of devices such as the music player and photo camera become even more 'real' with this portable hardware, to such extent that the other devices become completely integrated in someone's 'phone'. Contributory to this is that the smartphone contains a variety of sensors that make it possible to simulate these other devices to a fuller extent and add new devices to the possibilities of information technology. Most smartphones have for instance - in addition to receivers for phone signal, Wi-Fi, mobile data and GPS, a microphone and cameras - an accelerometer to measure movement, a gyroscope to pinpoint orientation, a magnetometer for the compass, a light sensor and some add thermometers, pedometers, humidity sensors and heart rate monitors (Swan 2012). All these sensors allow the smartphone to now also extend sets of means that concern the tracking of one's health, measurement of environmental features and other services that concern the specific location or state the device is in. In addition to acquiring the

extending (the sets of means related to) the mind, the smartphone has thus also added the ability to extend even more of the world's material means to realize an even wider variety of intentions.

The teleological dimension: Portable information technology as an extension of the self

Because of its many functions, the smartphone can be an extension to realize individual, shared and organizational intentions all at once. Its emphasis however seems to lay on the realization of intentions of the individual owner. To do this, it is a highly versatile device and the intentions in all of the categories described in the earlier sections can be realized by it; professional and private intentions, concerning information, communication, entertainment and everything else that information technology can realize. Smartphones have grown to be an especially important artefact for the individual user. Around two thirds of Americans consistently use their smartphones for a large variety of applications, such as navigation, to search information concerning their health, follow the news and for nineteen percent of American smartphone it is the only source of internet (Pew Research Center 2015). In this way, information technology has more and more become an unmissable technology in the life of the individual human. As Jane Vincent (2006) writes "[Mobile phones] become the repositories of our memories and social connections in the phone numbers, photos and messages that they store. The phone becomes an icon of 'me, my mobile and my identity'—something that embodies our social and emotional life rather than just merely enabling it" (p.39). A stronger coupling has thus grown between human and artefact as information technology has become portable, also due to the earlier discussed effects in which the smartphone is an extension of the mind and material extension of many interesting devices, such as music players, cameras and notebooks.

With all these functions and because a smartphone generally has only one user, the smartphone increasingly has become a personal beacon and this also makes that this portable information technology starts to feel as part of oneself, more so than earlier information technology was able to do that. Belk (2013) has linked this to his concept of the *extended self*. He observes that part of the identity of the user is stored in the device, through the memories and personas it carries, which makes it "the most relevant identity kit" (p.492). This idea, that the smartphone becomes a part of the self, is linked to findings where a temporal loss of one's phone feels as a temporary loss of a 'piece of oneself'. These were findings of Clayton et al. (2015), who performed a study that showed that "negative psychological and physiological outcomes are associated with iPhone separation" (p.1).

This shows the far extent to which the coupling between smartphone and user has evolved. As it starts to feel as part of oneself, the smartphone becomes an indispensable part of one's daily life, which allows the very strong coupling partly expressed in the extended mind thesis. The concept of the extended self should however not be taken to literally here. I introduced it here because it nicely concretizes the strong individual coupling with contemporary information technology, but it is not per se related to extension theory and does not fit the extension thesis, as it on itself does not relate to intentions being realized through that extension. Important to take from Belk's idea is that the feeling of information technological artefacts as an extension of the self allows the user to experience extending his natural means with it as even more 'natural'. The smartphone has thus increased the individualization of information technology even further. It has become a private beacon to realize all kinds of intentions, which are realized either collectively or without help other than the virtual.

This can also be formulated as that the 'coupling' between man and artefact has continuously grown throughout the development of information technology and the smartphone has become the premier example of this relation. It is therefore also interesting to shortly consider Heersmink's (2014) framework in which he has synthesized multiple theories on artefact coupling into a multidimensional framework. The higher a system of agent and artefact scores on these dimensions, the deeper the integration is and the tighter the coupling is. In light of these dimensions, it becomes even clearer that the coupling between humans and information technological artefacts has become tighter over the course of information technology and has today with the smartphone seen its premier example: First, *reliable availability* is an important criterion as I already discussed. Next, the relation between human and artefact is more *durable* due to much more moments of coupling and decoupling; every time a smartphone is used, or even shortly checked to see if there are any updates, the relation between it and the user is again strengthened. When a current phone is replaced by a newer version, the relation will shortly weaken, but due to high compatibility between devices the relation is quickly renewed in strength. Another reason that current information technologies have a tighter relation with their users, is that a high degree of *individualization* is possible, due to the many customizing options in functions, sounds and, especially, appearance. The final reason that follows from Heersmink's framework is that the relation between user and contemporary artefact is more *transparent*, in that the operation of the device is very intuitive to use. This thus again shows the extent to which the smartphone has become an extension that is primarily individual, a world away from the organizational mainframes it all started with.

Conclusion

The portability of information technology, in combination with its ease of use and reliable availability, has led to information technology extending the mind. The further progression of information technology and the incorporation of sensors into devices has also led it to extend the external world to an even further extend. The combination of these extensions has led many users to develop a tight bond with their smartphone, which can be labelled as 'extension of the self'. This displays the far extent to which information technology has now become part of the individual's private sphere and today's tight coupling between man and information technological artefacts.

3.1.5 Conclusion on the evolution of information technology

Having developed an analysis of the extension of information technology, from the very first computers to contemporary devices, I can now answer the first question of this chapter:

2.1 *How can (different) information technologies be understood to be technological extensions?*

It was concluded that the earliest computers formed a cognitive extension and did this in order to realize intentions on an organizational level. Advanced computers were able to also extend objects of the world, in a material extension and made computers available as an individual extension. The internet made it possible to extend more aspects of the world, by simulating locations and human interaction. By combining this with material extension, it became possible to extend the world. The internet also made it possible to realize shared intentions together with others on the internet. Contemporary information

technology added portability to these developments, which makes it possible for information technology to become an extension of the mind and a very tight coupling between man and artefact has emerged.

3.2 The extension of information technology: Information technology in comparison to earlier technological phases

I have now established an account of information technology as extension of the human being and shown how versatile it is considering all sets of means it can extend. I will here put information technology into perspective in comparison to artefacts of earlier phases of technology as to show how this way of extension is different from that of earlier technological phases. In that way I develop an answer to the second subquestion:

2.2 *Is the extension of information technology different from the extension of technologies from earlier technological phases?*

As basis of comparison, I identify mechanical technologies and electrical technologies as the two main historical phases of technology: Mechanical movement, generally in conjunction with human, water or animal movement, initially were the fundament of the performance of technologies. Steam engines expanded these mechanical possibilities by being able to use steam as basis for movement. With the discovery of the possibilities of electricity however, completely new technologies were introduced such as the electrical light bulb, and television and radio that did not directly require any mechanical exertion; the electrical phase of technology. Below I will shortly consider what kind of extensions these technologies provided. I compare information technology to these extensions to understand it as a potentially new 'phase' of technology.

To start this comparison of information technology to earlier forms of technology, it is clear that different artefacts from these different phases form extensions to different sets of means in order to realize different intentions. A hammer for instance is used to realize very different intentions than an electrical light bulb and the function of a laptop is altogether different from this. In understanding this difference in intentions to be realized lays the key to understand how information technology as an extension of the human is different from that of mechanical and electrical technologies. If we namely overview the different intentions to be realized by means of artefacts from these phases, we see different general forms of extension. I will here discuss the phases and how we can generally understand artefacts to extend the human being or environment. To do that I will shortly summarize what it is that is extended – the ontological dimension – and to which intentions these are generally deployed - the teleological dimension.

For *mechanical* technologies, the relevant intentions generally concern physical efforts, such as carrying weight, transportation, or construction. To realize these intentions, mechanical artefacts often mimic functions of the body. A hammer for instance mimics the arm and a car mimics the body with its legs for transportation, an idea which already originated with Kapp's (1877) first philosophy of technology. Although Kapp might have formulated this 'Organprojektion' a little too strict - as we saw in the second chapter - mechanical artefacts do focus on bodily functions, which we can also understand with the established extension thesis: mechanical technologies extend bodily sets of means. Concerning the

teleological dimension, a thorough analysis is not appropriate here, but it seems these mechanical tools were most used as to realize organizational intentions, concerning production for instance, while certain apparatuses could also serve the individual or shared intentions concerning for example transportation.

With *electrical* technologies, new sets of means could be extended. While electricity allowed a more efficient and convenient extension of the bodily faculties, now also intentions that were related to the senses could be realized. In this way, electrical technologies are generally aimed at making our lives more comfortable. Electrical light and television for instance target the eyes and ears and a heater targets the skin. In this function, McLuhan (1964) saw electrical technologies as functionally resemble the nervous system, in the way sensory input is altered. Electrical artefacts indeed generally extend the set of sensory means to realize intentions related to those senses. Concerning the teleological dimensions, these electrical devices seem especially suited to realize individual intentions, but these sources of light and warmth of course have a role in each of the distinguished levels of intentions.

Understanding *information* technologies then was what we were occupied with in this chapter. In section 3.1 I have discussed the different kinds of extensions that are provided. It was concluded that information technology can form an extension of cognitive processes of the human, but information technologies can also extend material objects by means of simulation. With the developments of the internet, information technology becoming portable and overall progressing micro-electronics, these functions have evolved in the possibility to extend the mind and extend many aspects of the material environment. As I explored in the teleological dimension, the developments also led information technology to be able to realize intentions on each distinguished level.

Thus, overviewing the timeline of technological artefacts, we can see that mechanical technologies generally form extensions of means concerning bodily faculties, electrical technologies concerning sensory faculties and information technologies concerning mind faculties and simulation of the environment. Within the teleological dimension, we could distinguish a shift from a focus on intentions on the organizational level to more individual-based technology, but these differences are not as significant, because each kind of technology seems to have some role on each of the possible levels. The conclusion as to what it is that is extended does however emphasizes the important observation that information technology can be understood as a new phase of technology, that extends us and the world around us different than possible ever before.

3.3 Conclusion

In this chapter, I first developed an extension account of information technology by considering different important steps in its evolution. At every step, I conceptualized the extension of information technology by investigating the ontological dimension - what it is that is extended - and teleological dimension - to whose intentions the extension forms a means. In that way, I developed an answer to the first subquestion of this chapter:

2.1 *How can (different) information technologies be understood to be technological extensions?*

The analysis showed that the earliest computers were a cognitive extension, extending the natural cognitive set of means to manipulate and store data, and were used to realize intentions on an

organizational level. Then, as computers and storage memory started to develop, also an extension of specific entities of the physical world became possible due to digital simulation of those entities. At the same time, for the teleological dimension, information technology also became available for the individual to use at home to realize individual intentions. The internet was a next important step, which enabled new material extensions and the extension of locations and human interaction, culminating in an extension to the world. With the development of this online medium, information technology became able to realize the intentions of not just individual users, but those shared by users simultaneously.

The latest important step of information technology is to become portable, with the smartphone as premier example. This allowed a further coupling, which enabled a further extension of cognitive faculties; an extension of the mind. Due to this development and the simulation of many other devices, the smartphone has become a very important extension in its user's everyday life; a kind of extension of the self.

I then turned to the second subquestion:

2.2 *Is the extension of information technology different from the extension of technologies from earlier technological phases?*

I showed that as mechanical technologies extend the bodily means and electrical technologies extend the sensory means, the role of information technology as extension of the mind and the world is different from artefacts of those earlier technological phases. Interesting about the evolution of information technology furthermore is that its development is accumulative. While the latest developments allow an extension of the mind and individual extension, information technology as a purely cognitive extension is still relevant (for instance for accountancy programs or data processing) and its role as an organizational extension also remains important in many institutions. It is thus that we can conclude that contemporary information technologies have the capacities to extend the human mind and the material world to realize intentions of the individual or larger collective, but that different kinds of information technology use these capacities differently to enable different kinds of extensions.

After having answered this sub question, the next question becomes what this means for the relation the human has with information technology; what the impact of the extension of information technology actually is on the human being and its capabilities. This is what we will be concerned with in the next chapter, as we research the effect of the extension of information technology on the flourishing of the individual human being.

Chapter 4: Normative implications of the extension account of information technology

In the third chapter I established an extension account of information technology and showed the different ways in which information technology extends the human being, both in relation to other phases of technology and considering the evolution of information technology on itself. In this chapter, I will develop an understanding of what the impact of this extension of information technology is; the impact on the human being, who himself as well as his lifeworld are extended.

In the second chapter I argued that an extension account of technology does not imply that technology is neutral, but actually provides the means to assess its normative implications for the human and his lifeworld. Kapp (1877) and McLuhan (1964) for instance investigated these implications for mechanical and electronic technologies respectively. In this chapter, I will research what the extension of information technology does to the human being. To be able to analyze the extension of information technology in a normative way, first an appropriate approach has to be established. Therefore, the subquestion will be answered:

3.1 *How can the impact of the extension of information technology on the flourishing of the human being be analyzed?*

I will explain that the most appropriate approach is one that limits the scope to the effect on the *individual* human being, as also encompassing societal effects would make the analysis insurmountably large. Furthermore, I will focus on the effect on the *flourishing* of that human individual. As I will explain, this means that I will not inquire towards the subjective happiness of the human who is extended, or on the many ethical questions concerning information technology; I will analyze the influence of information technology on the possibilities for the human to thrive; how the extension of information technology encourages or limits leading a flourishing life.

With this approach, the extension of information technology can be normatively assessed. Thereby, I will not claim to fully understand all effects of information technology, but focus on general ways in which this flourishing is affected. In this way the subquestion is answered:

3.2 *In which general ways is the flourishing of the human individual affected by the extension of information technology?*

4.1 A normative approach

Many different approaches can be used to evaluate impacts on the human being. The first important distinction is between theories of s*ubjective well-being* (also called hedonia) and theories of *eudaimonia*, objective well-being (Deci and Ryan 2008). Theories of subjective well-being evaluate the effect of something as it is felt by the human himself. Alternatively, theories of eudaimonia (εὐδαιμονία) evaluate the 'good life', the fulfilling of one's potential, by means of certain non-subjective criteria. In the next two sections I will investigate these two different approaches and argue what kind of approach is most suitable and valuable as basis of this chapter.

4.1.1 Subjective well-being and eudaimonia

A subjective approach to well-being says that what makes a human being attain a high level of being is related to what he subjectively wants, likes, cares about or connects with in some way. The two main theories within this approach are *hedonism* and *desire satisfactionism*. Hedonism defines well-being as pleasure over pain (Moore 2013) and evaluates it by comparing the total pleasure and pain it has or will accumulate over time. Desire satisfactionism says that an increase of well-being is the result of a satisfaction of desires, the content of which dependents on the individual.

Hedonism and desire satisfactionism work on quite basic principles and are therefore easy to understand, but have also seen quite some criticism as approaches to evaluate situations in regard to well-being. Hedonism is generally challenged because also other values or issues are considered important than only pleasure and pain. While desire satisfactionism overcomes this limitation, it is criticized because desires cannot be deemed wrong in this account, which is especially a shortcoming concerning the evaluation of more drastic choices in one's life. A famous example to show this challenge in desire satisfactionism is the case in which a brilliant Harvard mathematician desires to only count blades of grass on the Harvard lawns, where desire satisfactionism does not allow us to question his desires (Crisp 2014).

Both main subjective approaches to well-being have thus been challenged. There are more sophisticated theories within this approach, but also as a whole the subjective approach has been criticized, for instance by Seligman and Royzman (2003) who I believe have formulated the critique especially well in an example where they describe children roaming the streets for whom "it seems conceivable that their existence, consumed with meeting momentary needs, adventurous roving in gangs, casual sex, with little thought for tomorrow, might actually be subjectively 'happy'". As the authors say, in such a case, most of us would however be reluctant to actually classify this existence as 'happy', as a good life to attain.

Seligman and Royzman pose a major challenge, but we should also understand that every theory of well-being has been challenged. If not, this field would probably not have gathered the interest of so many philosophers throughout the millennia. By nature, every theory has its limitations and advantages. The subjective approach to well-being is however particularly ill-suited for the research at hand here because it provides some major obstacles that frustrate a worthwhile and in-depth analysis for the purpose of this thesis:

First, information technology is a broad category of technology with many different aspects, way of use, and different artefacts as also emerged from the third chapter. Analyzing such a category of technology by means of the subjective approach would result in a very cluttered analysis with many different sides in which information technology can affect the subjective states of well-being of individuals. Individuals use information technology differently and in different situations, and while this might indeed lead to different impacts on subjective feelings of well-being, evaluating 'general ways' in which these are impacted would not generate any interesting insights about information technology. Focusing on specific uses of information technology could mitigate this problem, but would then not correspond to the objective of this thesis to evaluate what general ways are in which information technology affects the individual.

Second, because technology in general, and information technology specifically, has become so integrated into our lives, it has the potential to change – and probably already has changed - how we conceive what is pleasurable or what our desires are. An example of such technology today is for instance the mobile phone which, although it only exists for 40 years (and much shorter in the mainstream public domain), has for many quickly turned the ability to be reachable by other people from a luxury into a necessity and we can see similar developments concerning for instance the availability of a wireless internet connection. Technology can thus change what makes us subjectively happy and these effects would conflict with the aim of understanding the impact of information technology on flourishing on a general level.

A subjective approach to well-being thus would produce an analysis that is too cluttered and too complex concerning all the effects of information technology. An objective approach can overcome these limitations; it is not bound to analyze all effects of information technology on the subjective states of the human-being, but can focus on general ways in which it affects the human being by means of a specific understanding of what important effects are. These effects can be analyzed by means of standards that can be argued to be timeless, overcoming the need to take the dynamics into account of how information technology affects subjective human states.

Furthermore, an objective approach allows us to investigate whether something should be deemed good or bad and to evaluate the characteristics of information technology, without having to encompass the specific desires of individuals. The example of Seligman and Royzman already showed that this is valuable, because it allows a further evaluation of cases than merely the experience of the persons involved. Another example that shows the value of being able to step away from subjective states of being, is that it has for instance been suggested that receiving and sending messaged initiates a shot of dopamine which leads to a feeling of pleasure (Weinschenk 2012). We would want to be able to question however whether spending all day receiving such mini-dopamine shots is actually a flourishing life. An objective approach is most suited to do so.

4.1.2 An objective approach to flourishing

Objective theories of happiness seem thus more appropriate, as they hold that well-being is the result of a number of objective conditions. Flourishing is then evaluated by certain criteria; it is a state of being, not something to be felt or experienced.

The objective approach has however also been criticized and let me first address these critics' main point. These critics say that authors within the objective tradition have to "resort to unacceptable claims of self-evidence and/or to some mysterious faculty" (Varelius 2004) in order to defend their theories. I agree that this is the main challenge in formulating an objective theory of what well-being means – to convincingly formulate and ground what the objective criteria are. I do not believe however that an objective theory is therefore per se unsuited. My first reason is that while indeed defending an objective account ultimately comes down to intuition or for instance a grounding in human nature, this does not mean we cannot rationally discuss and evaluate the relevance and value for using a certain understanding of grounds of what we find to be well-being. Many philosophical theories cannot be 'proven' in any way, but this does not mean that we cannot consider the strengths and weaknesses of

different theories in order to arrive at one that is most suitable and corresponds best to our beliefs and intuition. My second argument is that subjective theories can be subjected to the same point of critique, although less obvious. Also a subjective theory of what constitutes well-being ultimately has to formulate a certain assumption or intuition as to what well-being means. For hedonism this is for instance that a high level of well-being means a high ratio of pleasure over pain and desire satisfactionism is based on the assumption that one has a higher well-being as more of his desires are satisfied.

These reasons lead me to believe that while objective theories indeed struggle to find a justified grounding of their understanding of well-being, this should not keep us from exploring these theories, especially as I already showed that the subjective approaches to well-being are not satisfying for the research question at hand.

There are different approaches within this objective tradition. Some authors have formulated a list of such conditions, the so called 'objective list approaches'. Ross (1930), Finnis (1980) and Griffin (1986) have for instance listed conditions such as knowledge, friendship, the development of one's abilities, autonomy or moral goodness. Another very influential kind of objective approach is a *perfectionist* approach, which states that what is good is ultimately the development of human nature (Hurka 2011). Other objective theories can focus only on a single or a few criteria, or take a more meta-perspective. We now need to find an approach that is appropriate for the evaluation of the extension of information technology.

If we consider approaches that formulate a list, we can see that they are valuable because they can be quite practically used to assess something. An analysis of the extension of information technology would however leave us with an enormous undertaking: to arrive at a sensible analysis of every different form of information technology on each of the values in the list. If we for instance want to understand how the different forms of information technology affect our sociability (Finnis 1980), understanding (Griffin 1988), pleasure (Ross 1930) or being a good parent (Parfit 1984), extensive researches would have to be carried out to first appropriately formulate such value and then evaluate (the extension of) information technology. And then we have only yet understood one such effect or one aspect of information technology.

Considering all values of an objective list in relation to the aspects of the extension of information technology thus does not seem a very appropriate approach concerning its scope. It might then also be more constructive to focus not on all values that are deemed important, but on one or a few, the most important ones. Concerning the objective lists approach however this is difficult as these generally contain values that are incommensurable: There is no single important value and thus without a proper analysis of all these values, there seems to be no ground to really evaluate something. Although I believe understanding information technology as an extension can shed new light on these issues related to the values on the objective lists, trying to coherently understand all ways in which this extension affects all the different criteria of a list seem unsurmountable and not in line with the objective to discover *general* ways in which flourishing is affected.

Instead of an objective list approach, an approach that is more precise in scope is more appropriate. I will therefore, instead of focusing on a few values of one objective list approach, turn to the basis of many other objective approaches of flourishing: perfectionism. A perfectionist approach provides a way to understand the flourishing of the human being by relating to a more specific concept: the development of oneself to excellence and reaching one's potential as a human being. As I already discussed, the ultimate grounding of such theory is in self-evidence and intuition, but I believe that as a grounding of what constitutes the flourishing of the human being, a proper functioning of all his faculties seems of large importance. Not being able to develop one's faculties hurts the human being's flourishing, being unable to reach his potential excellence. The development of one's abilities to their potential I thus take as the premier requirement in order to flourish and the question is whether the extension of information technology limits this in the way it extends sets of means to realize intentions, or that it contributes to it with the new possibilities it unlocks. And even when one does not agree that the development of oneself is the ultimate criterion for flourishing, it would be hard to deny that it is at least *one* important criterion, which still leaves much value to a perfectionist analysis. Furthermore, the perfectionist approach seems quite naturally suited to an extension understanding of technology, as we can then question to what extent the human has the possibility to keep developing his own abilities – the human's 'naturally given means' - with these technologies entering his lifeworld.

Perfectionism thus has to do with the striving and development towards human excellence, but there are different conceptions of what perfectionism exactly entails in this context. John Rawls said that perfectionism is the aim to "maximize the achievement of human excellence in art, science, and culture" (Rawls 1971, 286). Wilhelm von Humboldt said that it was "the highest and most harmonious development of [man's] powers in their perfect individuality" (Humboldt 1969) and William Hamilton (1836) as "the full and harmonious development of all our faculties, corporeal and mental, intellectual and moral" (p.14). Other authors formulate a definition of perfectionism concerning human nature. Sidgwick (1874) said it was "excellence of Human Nature", and more recently Hurka (1993) developed an account in which he combined the Aristotelian theory of human nature with the perfectionist idea, which leads to seeing the development of the human's physical nature and theoretical and practical rationality as intrinsic goods.

Each of the definitions of perfectionism is interesting for its own reasons. I find Hamilton's definition of perfectionism most appropriate and interesting as basis for the analysis. This has three reasons. First, it focuses on the development of a human's own qualities and can as such be used to understand how external developments affect this development of faculties. This is more relevant for an analysis of the effect on the individual human being than for instance the account of Rawls that focuses on how developments affect external institutions, that only in a second instance affect the human himself. Second, Hamilton provides a brief description of what valuable faculties are for the human to develop. It gives both a clue where to 'search' for effects on flourishing as well as giving room for further exploration of the subjects, which is an advantage over for instance Humboldt's account. Third, as advantage over Hurka's account, Hamilton does not appeal to any theory of human nature. While perfectionism is always in some way concerned with human nature, Hamilton's version does not require it as a basis. It is concerned with human excellence and not per se with human excellence defined by

human nature, as Hurka also admits (p.4). This has as advantage that it is a more general account and more suitable for the objective to find general ways in which the extension of information technology affects the human flourishing. A counterargument against using Hamilton's definition is that it is not specific enough. This argument is relevant regarding theoretical discussions on well-being and perfectionism. I believe however that for the purpose here, it is actually rather appropriate that the theory does not spell out all possible ways for the human to flourish, but provides a general understanding of what it means to flourish. Hamilton gives an indication in which fields there are valuable faculties for the human to develop – the corporeal and mental; intellectual and moral – and thereby provides a basis to understand how these are affected by information technology. A more detailed approach to what valuable faculties are, would require also a further more detailed understanding of how information technology can affect these, which would require a much more empirical and specified analysis. This would not suit this thesis both because of scope restrictions and because we are interested to further analyze the account of information technology developed in the third chapter, not a different account based on empirical research and use.

Hamilton's definition of perfectionism thus provides the most interesting ground to normatively assess the general ways in which the extension of information technology affects flourishing. There is however one compelling argument against the general perfectionist understanding of flourishing that I did not discuss yet. This is the argument that perfectionism gives a paternalistic understanding of when a human being has a high level of well-being. It is argued that taking such a notion as a basis of normative assessment deprives the human being of choosing his or her own conception of the good and can result in *elitist* arguments (Crisp 2014). This accusation is one often encountered in perfectionist discussions and there have been multiple ways to counter it. The first one is to deny or refute it; Hurka (2002) for instance has argued that perfectionism results in arguments for material equality. Another way is to introduce a separate criterion of 'autonomy' as one essential to the human nature. I believe that for the analysis at hand we should not focus on how the extension of information technology impacts the human perfection itself, but how it affects the *opportunities* for a human to develop his potential. In this way, no elitist arguments are imposed in the approach, but the issue at stake becomes the *possibility* for a human to develop himself. We can assess how the extension of information technology contributes or limits these opportunities. I thus understand the human flourishing at stake in the evaluation to be "the opportunity to fully and harmoniously develop all human faculties".

An approach that allows the incorporation of the concept of 'opportunity' - the dimension of individual autonomy - is to assess what information technology allows the human to be or do in a certain situation. Sen (1985) formulated such an approach, as he developed a framework which allows the assessment of how beings and doings are enabled, which he calls the human *functionings*. This is the *capability approach*. He developed this 'evaluative space' as a reaction to his dissatisfaction with existing ways in which happiness was conceptualized. Sen thought that not resources themselves are of interest, but whether one has the ability to benefit from these resources to acquire valuable functionings in life. This approach often takes a specific list of such valuable functionings, but I will argue that it is for the evaluation at hand more appropriate to take a perfectionist perspective without having to formulate an exact list of valuable functionings.

What the capability approach in summary will allow me to do is to take the extension account of information technology and to tie this into a perfectionist analysis without taking a paternalistic view on how the human beings should act in life. Thus the general ways in which information technology affects the individual human life can be assessed without having to make claims how this extension should be used or developed. Only after this normative analysis, such claims on the use of information technology are appropriate, as we then have gained a sophisticated understanding of the effects. As the capability approach forms a main part of the methodology to develop conclusions, in the next section I will explicate this approach.

4.1.3 The capability approach

The background for the capability approach is formed by Sen's argument that we should not judge people on the basis of wealth or resources, but by the doings and beings – the functionings - those resources enable (Johnstone 2012). As said, Sen however also respected that different humans can make different choices. What is relevant is a person's *ability* to achieve a high level of functioning, irrespective of whether that is actually achieved. This ability is reflected in the concept of *capability.*

The standard formulation of Sen states that "a person's capability refers to the alternative combinations of functionings that are feasible for her to achieve" (Nussbaum 2011, 20). The capability approach is about *having the possibility* of attaining a good life (Sen 1992). It could for instance be argued that every individual should be provided the opportunity to be part of a community and to practice a religion, but if someone prefers to be a hermit or an atheist they should be free to do so (Robeyns 2005, 95). In this perspective, the flourishing being is one who has the capabilities, the 'freedoms', to achieve functionings concerned with the development of his faculties.

The capability approach comes in especially useful in my analysis because it is a way to understand how such capabilities come to being. Therefore, four major concepts are of interest: *goods*, *conversion factors*, *functionings* and *capability* (Robeyns 2005, Sen 1992). In figure 2, the relation between these concepts is depicted and below I will further explain them.

Goods are things or services that have certain characteristics that make them of interest to people. Humans are not interested in a bike because it is an object made of certain materials in a specific shape or color, but because it can take us to places where we want to go, faster than walking. These characteristics of a good or service enable a functioning, which is here the functioning of mobility.

The relation between such a good and the functioning(s) that can be achieved, is affected by *conversion factors*. Sen (1992) distinguishes three kind of conversion factors:

- Personal conversion factors influence how a person can convert the characteristics of a good into a functionings. Examples are physical condition and intelligence.
- Social conversion factors play on a social level and are for example public policies, social norms or gender roles.
- Environmental conversion factors also affect the translation from goods into functionings, for instance the climate and geographical location.

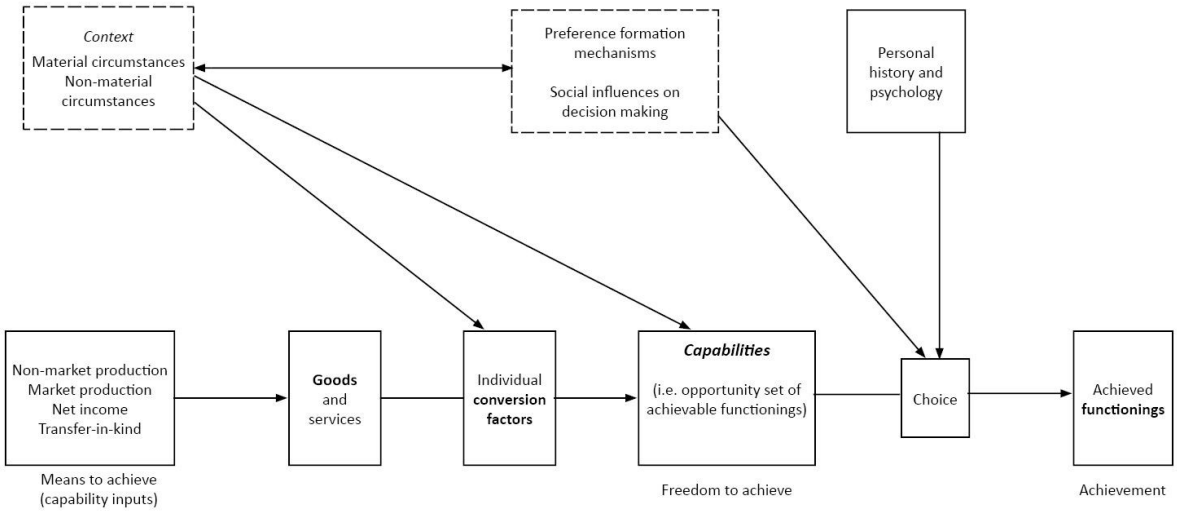

Figure 2: Presentation of a person's capability and the relation to goods, functionings and context (adapted from Robeyns, 2005, p.98)

What these conversion factors make clear is that knowing a person's goods is insufficient to know which functionings he or she can achieve. In addition to these conversion factors, there is also a context with material and non-material circumstances that shape people's opportunity sets and influence the choices people make from the capability set.

Functionings were already introduced and concern the doings or beings that can be realized with a certain good. *Capabilities* reflect the ability for an individual to achieve these functionings.

The dynamics between these concepts can be used to understand how information technology affect capabilities. While the capability approach provides a very interesting framework, it has also attained criticism. There are two main points of critique (D. A. Clark 2005) that I will shortly discuss and what the implications of these are for my research. First, it is argued that the capability approach has unrealistic informational requirements. Comparing different situations depends on acquiring data in regard to many different functionings and situations from which capabilities can emerge, data that is not always realistically available. This point of critique is not relevant for the research objective of this thesis, as we investigate not different individual situations, but only in general how capabilities of the individual human are affected. To analyze these effects, it is not needed to have all specific data on each situation in which information technology plays a role.

The second point of critique is that the capability framework is not operational because it does not provide a way to identify valuable capabilities. This is relevant because for a normative analysis we would for instance probably concern the capability to be educated more valuable than the capability to conveniently kill somebody. This is a relevant point of critique, but one that can be solved by incorporating a way to evaluate capabilities within the capability approach. Some authors have formulated specific lists which formulate such valuable capabilities (e.g. Nussbaum 2011, Robeyns 2011). These lists however are not an appropriate grounding for the research at hand, because these generally

concern situations where quite 'basic' human capabilities are at stake, such as being able to live in good health or live with concern for other species. With information technology we are not necessarily concerned with the effect on these basic capabilities, but interested in the more advanced capabilities that provide the opportunities for the human to not just live a life free from harm, but a life of opportunities to develop oneself to excellence. This is exactly why the perfectionist perspective suits the analysis very well: For the analysis of the extension of information technology, I am not concerned with a list of valuable capabilities as is sometimes used, but with a perfectionist grounding of what valuable capabilities are; the capabilities that contribute to the opportunities for the human being to develop himself. Dynamics that contribute to these capabilities are thus evaluated as positive, while a frustration of these capabilities or of the opportunities for development themselves are classified as negative in light of the human flourishing.

Perfectionism thus provides a way to evade the criticisms on the capability approach and contributes to it, by giving insight into what constitutes a flourishing life. Using a perfectionist approach within the capability approach has (as far as I know) never been (explicitly) done. This is however a valuable combination: the capability approach provides an interesting and valuable methodology to evaluate how the *flourishing* of the human individual is affected, which concept subsequently understand by means of the perfectionist approach. In this way, both the 'elitist' arguments against perfectionism and the 'non-normativity' argument against the capability approach are countered.

With these insights, I can now answer the first subquestion of this chapter:

3.1 *How can the impact of the extension of information technology on the flourishing of the human being be analyzed?*

First, I have developed an understanding of flourishing that takes a perfectionist basis, concerned with the individual developing himself and introduced a dimension of autonomy. Flourishing is thus defined as "the opportunity to fully and harmoniously develop all human faculties". To be able to analyze the impact of the extension of information technology on this concept of flourishing, I introduced the capability approach which provides an understanding of the dynamics in which these relevant opportunities are created. With this approach established, we can now start with the evaluation in order to answer the second subquestion:

3.2 *In which general ways is the flourishing of the human individual affected by the extension of information technology?*

4.2 A normative assessment of the extension of information technology

Let us now start analyzing our subject: the impact of the extension of information technology. In the third chapter, I developed an extension account of information technology. I there analyzed the different 'stages' of information technology to develop an understanding of the kind of extension that became available. In this analysis, I will focus on *contemporary* information technology. Therefore, an important observation is that the development of information technology and its extension is 'cumulative'. Ways of extension that became available with the first computers (i.e. cognitive extension) are still available and used on today's computer devices. The same goes for the subsequent developments; the possibility to

extend objects of the world, the new extension by means of the internet, and the development of portable and cloud computing. Today's computer thus encompasses all previous possibilities and it is the impact of this contemporary stage of information technology that I will analyze. In this way, I develop an understanding of the effect of contemporary information technology on the flourishing of the individual of today, but also of tomorrow as it can be expected that also future information technology developments will encompass and further develop today's possibilities.

From chapter 3, the following can then be concluded for today's information technology as to provide the basis of the evaluation:

"To realize intentions (1), contemporary information technology extends cognitive faculties, material objects, the world and the mind (2). In a tight coupling, it can extend these sets of means all at once and realize intentions on an individual, shared or organizational level (3)."

To come to an understanding of its impact on the individual's opportunities to flourish - to fully and harmoniously develop all human faculties – I will in the next sections develop an understanding of this way contemporary information technology is an extension. Therefore, I will dissect the three above established characteristics and evaluate them by means of the established perfectionist capability approach.

I placed bracketed numbers in the above conclusion on information technology, as to systematically analyze the different characteristics of the extension of information technology. I will first focus on the element of *intention realization* by means of the many kinds of extension information technology provides (4.2.1) and then consider what the consequences are of *what* information technology extends (4.2.2). After that, I will analyze the fact that contemporary information technology provides many extensions *at once* and can realize intentions on both an *individual, shared and organizational level* (4.2.3). Having now established the extension account of information technology and an appropriate approach to evaluate this, let us commence on the normative analysis.

4.2.1 The impact on flourishing: Information technology, an extension to realize intentions

Perhaps the most important conclusion of the third chapter was that information technology is an extension of many sets of means and can thereby be a means to realize many different intentions: material, cognitive, and many subsequent varieties. It is clear that the way information technology extends all different sets of means is very efficient and convenient for the user. A word processor (like Microsoft Word), overcomes physical restrictions and thereby makes the experience of writing and re-writing something much more convenient and efficient than the pen and paper it simulates. More examples concern sending an e-mail instead of writing a letter and online banking instead of having to go to an actual bank office. And the list goes on with many processes that the extension of information technology has improved concerning the convenience and efficiency of the experience: communicating with people on the other side of the world, searching information, storing files, following courses, staying up-to-date of friends' activities, finding like-minded people, keeping an agenda, writing a thesis.

Within the established capability terminology framework, we can understand that information technology has become a very convenient *good* for the individual to achieve *functionings*. It is this aspect

of contemporary information technology that requires the first analysis within the normative approach that was established. We want to question what the effect of it is on the opportunities for the human to develop oneself, i.e. the impact on the flourishing of the individual.

To be able to normatively assess this effect on flourishing, we should not only be interested in the question whether the intentions *are* realized by some extension, but also understand *how* these intentions are realized: There can be other 'effects' than purely goal-driven ones that are put into motion by a certain way of doing things. It is therefore helpful to consider what the sets of means contain that information technology extends. Microwaving a steam dish and cooking a dinner out of fresh ingredients, for instance both realize intentions to fill the stomach, but achieve completely different functionings aside from realization of that specific intention of being satisfied with food: A microwave dish can increase the functioning of flexibility or mobility, due to its very short preparation time. Cooking a meal yourself however, can provide opportunities to learn about ingredients and develop one's cooking skills.

An extension of valuable sets of means

So let us consider the way information technology realizes intentions and the value of the sets of means it thereby extends. A philosopher that can help us here is Albert Borgmann, whose philosophy is also concerned with technology as a replacement of existing means. I will discuss his observations of technology and show how they uncover an essential danger that can be related to the extension of information technology. To understand Borgmann's philosophy of technology, I will first cover his most important conclusions from his book *Technology and the Character of Contemporary Life* (1984).

Borgmann's first important observation in this book is that technology generally realizes intentions much 'better' than other ways of accomplishing the same goal. Technologies make all kinds of pleasures and desires easily available to us, without requiring much attention. This is the way technology makes a functioning a *commodity*. While Borgmann was here not concerned with information technology, it is clear that these aspects of technology are still present in that form of technology of today. In providing these commodities, Borgmann explains, technology disburdens people; technologies decrease the effort needed to accomplish things - or in terms of extension theory, to realize intentions - which is exactly the reason technology is used. Borgmann argues that there lies an enormous danger in this disburdening: it leads to disengagement with reality. Engaged practices get replaced by the consumption of commodities, in a pattern what he calls the *device paradigm*.

Borgmann's paradigmatic example of this disburdening character of technology is the turn in history the use of the hearth to a central heating system. With the modern heating system, we simply have to adjust the thermostat, and heat is at our disposal. This is the role of a technological *device*, it makes heat directly available to us, as a commodity. A hearth however, is what Borgmann calls a *focal thing*. It created an intense form of engagement with reality: wood had to be chopped, the hearth had to be cleaned and filled, and people sat around it together. It is this engaged way of interaction with the world, that a device takes away.

I think this philosophy of Borgmann is valuable for the normative understanding of the extension of information technology, because it shows us that whereas technology very efficiently can realize

intentions as a device, it could disengage us with the actual processes and thereby can forego opportunities for development that 'things' would have created. The replacement of focal things with devices can thus also mean a replacement of situations that would have created valuable capabilities with goods that lead to the direct achievement of a single functioning.

What information technology cannot extend

Not only Borgmann's early work is interesting for the research question at hand, also a later (2000) book is interesting, where he turns to information technology. He there concludes that *information* technology more specifically replaces valuable means by creating a *hyper reality*. Borgmann distinguishes there three types of information: natural information, cultural information, and technological information. He argues that while natural and cultural information are grounded in reality, technological information is not grounded in any reality. It is information *as* reality. When listening to a CD, there is not a report about a concert, or instructions how to play one; the information it contains is realized as a reality in and of itself. Borgmann says that this technological information is the basis of information technology. He argues that technological information is not capable of engaging humans with reality in this simulated world, because it is not tied to the actual reality itself anymore, while earlier forms of information were. People are however drawn to this hyper reality of information technology, as it is 'more real than reality itself'.

Borgmann's philosophy thus argues that there is something inherently disengaging in information technologies as these construct a hyper reality. Interestingly, these ideas can be linked to what we observed in the third chapter as the material extension of information technology. Parts of reality are simulated and it can be questioned whether these still have a link to the actual reality. If indeed such a hyper reality is generated by information technology, faculties developed there will not have any grounding in the actual faculties that make a life a flourishing one. Opportunities for the development of valuable faculties are then also cut short, as information technology so easily commodifies the realization of related intentions. A further troubling note from the third chapter, is that we can lose the ability to even recognize such opportunities as the human becomes more tightly coupled with these information technological devices.

We might have to nuance this dark image a little however, because Borgmann is extremely black-and-white in his evaluation of technologies and information technologies in particular. We can for instance counter Borgmann's verdict concerning disengaging information technology with the question whether someone who uses the computer to make art and thereby creates inspiring artworks, is really disillusioned by a 'hyper reality'. Also it is hard to believe that the capabilities that this person accessed for this activity do not at all 'carry over' to real world abilities.

Verbeek (2002) similarly and convincingly criticized Borgmann, as he argues that what Borgmann calls 'devices' can be just as engaging as pre-technological entities. While devices indeed do not require people to exert themselves to realize an intention as with 'original means', Verbeek says that what constitutes a focal thing is not whether efforts and pains are involved, but whether the practice itself has a sense of meaningfulness. It is with that reasoning, that Verbeek opens the possibility that technologies themselves can actually invite engagement. While Borgmann sees the CD-player as a consumption-

provoking technology that makes music a commodity, Verbeek actually argues that it can lead to focal practices when for instance used to study music and engage with different styles. In similar ways, other examples of technologies can lead to engagement; a television game show can for instance invite a family for a focal practice with each other, and a microwave for more creative and unique cooking.

Verbeek provides an argument that shows that Borgmann is too quick in condemning information technology to disable all engagement. Verbeek thereby convincingly provides the insight that information technology does not necessarily exterminate all opportunities for personal development. I believe however that this does not mean that we should then also render the way information technology can overshadow alternative means to realize intentions completely innocent. If the reality is not as black-and-white as Borgmann pictures, we should wonder whether certain kinds of opportunities are affected more by the 'hyper reality' of information technology than others.

In this regard, Dreyfus' (2009) argument is interesting, as he claims that while some focal practices might indeed exist with the information technology, even in a world of commodifying devices, not all such events can be 'emulated' by means of information technology. He says that there are certain necessary requirements for focal events that cannot be met in the digital realm. These are related to the showing and retrieving of direct bodily expression ('intercorporality'), sharing of moods, and other feelings related to physical closeness and directness.

I find his argument convincing as he claims that the reason that these focal elements are non-extendable is that these need a sense of immediacy: Although the digital world allows one to express his or her emotions, in most applications the individual always first has to evaluate these emotions themselves, before being able to subsequently choose the right digital emotion to show it to others, by expressing this in text or by means of an emoticon for instance. This is a Cartesian model of communication, Dreyfus argues, one in which there is a hard split between one's inner world - where emotions come to being - and the outer world - where emotions are shown. However, in real-life communication both having the emotion and showing it are generally simultaneously and inseparable. Therefore, Dreyfus states that "[a]s long as one is confined in the current Cartesian model of the communication of feelings, programming the contagion of moods is impossible, and so focal events are not possible in current virtual world" (p.119).

The Cartesian model of communication that we find in many information technological applications seems to arise from the way human relationships are extended by means of simulation. As I discussed in section 3.1.3, the internet enables the realization of intentions together, but it provides simulation of the means to do so, interfering with the opportunity to feel a sense of closeness in realizing these. It is only in very specific applications that humans can directly share their emotions, i.e. using the webcam and microphones, and even then a certain feeling of immediateness and intercorporality is lost in the way the screens obstructs the possibility to actually be together.

I thus find Dreyfus insights convincing because indeed being physically close to somebody seems not possible by means of the extension of information technology, or at least not part of the general ways in which information technology is used to realize intentions. In this way, focal events, potential opportunities for development that require such sense of immediacy and mutual experience, can be

(unconsciously) lost. Dreyfus makes a good point and we might also be able to distinguish other aspects that information technology cannot extend. The extension of information technology for instance generally does not seem able to give us a feeling of closeness to objects such as buildings or artworks, to natural objects, or to beings of other species, because the material extension cannot bring us physically close to the actual object or being. Certain elements are thus not present in the way the extension of information technology can be used to realize intentions and this can affect flourishing. It is hard to estimate how significant we should evaluate this impact: Clearly not all elements of engagement are necessarily lost, as Verbeek shows us in his critique on Borgmann, but it is just as clear that at least some valuable aspects of focal events are not present in information technology. Instead of trying to spell out the exact 'ratio' between these two insights - which would require knowing what exactly constitutes an opportunity for development, what different kinds of opportunities are, what the requirements are for these kinds of opportunities and subsequently how information technology relates to these requirements – the important and valuable insights are:

First, that the extension of information technology affects the flourishing of the human individual in the general way that it can overshadow other means but can lack valuable aspects and thereby forego valuable opportunities. Second, that the relevance of this overshadowing in relation to flourishing can differ per situation. Replacing a visit to a museum for browsing art works online, a friends meet-up for an online chat or a visit to the library for the skimming of a Wikipedia-page; when consistently done these all seem to hurt the opportunities for the development these extended sets of means originally had to offer. However, playing a party game together with friends in the same room instead of a board game, looking up the route on the internet instead of a paper map or reading the news in a digital newspaper instead of a paper one do not seem to forego such important opportunities.

A further issue within the discussion of information technology as a good to realize intentions, is the question whether it might actually also create new opportunities for development, instead of only frustrating existing opportunities. This is an issue I will return later (4.4), as I now focus on the observation that information technology as a good can frustrate opportunities provided by alternative goods in the way it realizes intentions.

Conclusion: Consequences of the extension in order to realize intentions
We now arrive at the following conclusion: Information technology extends sets of means extremely well in terms of efficiency and convenience, but it can thereby block other means that could have created opportunities for personal development. Within the dynamics of the capability approach this means that technology is good that can be used to achieve many functionings, but can thereby overshadow other goods that might have led to valuable capabilities concerning opportunities for development.

In certain situations this effect can be more threatening to the human's possibility to flourish than in other situations. Especially the replacement of situations that involve human contact can be detrimental to flourishing, as human interaction cannot be fully extended to the virtual world. But also engagement with the world itself is important for the development of faculties. Borgmann calls such meaningful activities 'focal events' and there are indeed worrying developments that could limit these, especially the

use of extensions of worldly matters instead of those matters themselves and interaction with others via the internet.

As the efficiency and convenience of the extension of information technology blinds us of such opportunities, the opportunities for one's own development is negatively affected. The way information technology as a good allows us to realize intentions extremely well is both a blessing and a curse. As we take here the perspective of flourishing as the opportunity to develop oneself, the latter observation gets the upper hand, which is one of the general ways the extension of information technology affects the flourishing of the human individual.

4.2.2 The impact on flourishing: Consequences of cognitive and material extension

I have now developed an understanding of one characteristic of the extension of information technology, namely that it is used to realize many intentions in daily life. Let me here go into the ways in which information technology extends the sets of means. As set out in the third chapter, there are two main kinds of sets that are extended: cognitive faculties and material objects. These possibilities further evolved with later developments in information technology. I will here focus on an effect that both of these possible extensions entail and that is even increased because information technology encompasses both kinds of extension simultaneously: information technology focuses on the mind and enables it to realize intentions without exerting the body. I will show that this characteristic of the extension threatens important *conversion factors* related to the human *body*.

Let us therefore first shortly recap the way technologies extend the human being: Mechanical technologies extend the human body, electrical technologies extend the senses and information technologies extend the human cognition and also the material world itself. The development I now want to turn to already started with mechanical technologies: because of their mechanical extension of the bodily faculties, those original means were no longer required to realize intentions that had to do with power and movement. A car for instance can be used as an alternative of a walk and technological tools lift us from the burden of carrying weight, building furniture and many other manual tasks.

After these technologies that extended parts of the human body and thereby relieved it from many physical tasks, information technology as an extension further disburdened the body. Not only does our body not have to perform many tasks anymore, information technology even provided us with many of the material means in a digital world, by means of material extension. It is clear that this has an impact on the relation with these bodily faculties and the question is what this impact exactly is. As Dreyfus (2009) put this question: "Is the body just a remnant of our descent from the animal – a limitation of our freedom which the human race is now positioned to outgrow […] - or does the body play a crucial role even in our spiritual and intellectual life [?]" (p.6). I argue that there is quite something to say for the latter, that although information technology extends these bodily means very conveniently, in its disburdening character it can frustrate the opportunities to develop corporeal means. I will below show two developments that lead me to argue this.

The complete extension of the body

The first development concerns the observation that with information technology, mankind has accomplished a near-full extension of their original body. Except to keep itself alive and to – with

minimal physical exertion – operate the buttons to set the technological extensions in motion, no bodily activity seems necessary anymore for the human being in daily life. Because our body does not play an active role in the many activities information technologies invite us to, the value and state of the body might not naturally have as much meaning anymore. This can cause the human being getting out of 'touch' with his body, which can have detrimental effects to his well-being. Freund (1982) for instance argued that by being out of touch with the body, one of the most important human conditions is broken. The individual then loses control of the close integration which exists between the body and mind (Shilling, 1993).

As information technology replaces the need to exert the body by extending the mind and making object virtually directly at hand, opportunities to develop corporeal faculties are not automatically generated anymore. The life of today's citizen can be one of moving between different internet-connected places by car, making the body an obsolete part of what the human is. The matter of the relation of body and information technology is however not necessarily only about such neglect. On the one hand, information technologies overcome the limitation of the body but might thereby actually limit the body itself, on the other hand the body is still (for now at least) a requirement to access the digital realm (via mouse, keyboard, eyes and ears for instance). As counterargument for the bodily neglect via computers, one could also say that there is an upcoming development of information technologies that actually work in synergy with the body ('wearables'), but as of yet these only seem to be in a small minority as compared to the average daily use of information technology.

There is another important observation concerning the relation with the body, that will lead me to argue that there are indeed important bodily faculties hurt by the extension of information technology:

The body as an extension

The second development which can trouble the relationship with the body, is that the body itself might start to be experienced as an extension of the mind. As shown, information technology (and technology in general) forms an extension of the means to realize certain intentions. The relation with information technology has grown very tight and information technologies are in contemporary society often chosen as the 'default mean' to realize intentions concerning for instance communication, entertainment, memorization of facts etcetera.

As this is done with the mind and computer in a symbiotic relation (as argued in section 3.2.5), the danger is that the distinction between the way technological artefacts extend the mind and the body as an 'extension of the mind' vanishes; just as one can access technology to realize intentions of the mind, so one could also employ his body to realize those. Thus the body itself starts to be regarded as an extension of the mind - just one of the possible means to realize an intention.

Even more troublesome is that in such a comparison of means the body will then often prove to be less efficient than these 'other' extensions. In this reasoning, the body easily loses its 'competition' against technological means to realize intentions. This is what N. Katherine Hayles (1993) described as part of the process of becoming a 'posthuman', a being which "thinks of the body as the original prosthesis we all learn to manipulate, so that extending or replacing the body with other prostheses becomes a continuation of a process that began before we were born" (Hayles, p.3).

As such, it is not recognized that by this replacement of the body with information technological alternatives, opportunities to develop valuable faculties are foregone. The body *is* not simply an extension. The body is much more, as it regulates not only our health, but also emotions, experience and basic functionings to live. It is a basic requirement for the opportunity to perfection and thus flourishing of the human individual.

The Greek already believed that a the development of one's body was crucial to be able to lead a flourishing life (Hogenová 2000): Mind and body were compared to bow and arrow, which only when perfectly attuned to each other can be used to accurately hit the bull's-eye. Empirical studies have indeed found many positive relations between exercise, bodily fitness and measures such as satisfaction with life. Hassmén et al. (2000) for instance found that a decrease in exercise causes an increase in depression, anger, cynical distrust, stress and sense of coherence and McAuley et al. (2000) found in a study that older adults that exercised showed an increase on a scale of satisfaction with life. As we prefer other extensions than this body as our means, we might in that progress diminish the role of our actual body and lose the opportunities to develop it. Many valuable capabilities are then also limited, concerned with daily activities such as traveling, sports and social activities and it can lead to overall detrimental feelings such as being sick or depressed.

Conclusion: Consequences of the cognitive and material extension
By means of extension, information technology overcomes many limitations of the human body. In this subchapter I have however uncovered two troublesome developments that are detrimental for the relation between the human and the body and which lead to a negative impact on his flourishing. First, the body itself is today virtually entirely extended, as it is not needed for most daily activities anymore. This makes the human being to lose touch with the body. Second, the body itself might start to be felt as an extension of the mind, which leads to a disvaluing because it becomes equal to other technological extensions.

If we return to the framework of the capability approach, we can see why this effect is troublesome by observing that the body comprises important conversion factors. As explained in section 4.1.3, conversion factors determine how well an individual can convert the characteristics of a good into achieved functionings. As the body is less engaged, certain functionings might not be achieved anymore, not because the necessary goods are not available, but because the right conversion factors are not in place. Individuals might have access to goods that enable them to experience nature, enjoy a team sport, or visit an exciting country, but lack the personal conversion factors (e.g. bodily health or fitness) to achieve those. In this way, the opportunities to develop oneself - to become a flourishing being - are affected because capabilities to do so are frustrated.

4.2.3 The impact on flourishing: Everything extended, everything at once

After having discussed the effects of the efficiency and mind-focused nature of the extension of information technology, I will here focus on the third characteristic of the extension of information technology: the way information technology extends many different sets of means simultaneously. This gives additional insights into the way information technology affects the opportunities to develop oneself, i.e. his flourishing.

An important observation in the third chapter was that today's information technology carries all potential extensions that it has accumulated over its development. It provides all these different extensions - of the mind, of material objects, of locations and human interaction - simultaneously. Especially the smartphone provides not only the means to many kinds of intentions, but also many possibilities within these kinds: different applications to communicate, entertain or browse news and information. A very tight relation has emerged between the user and these computer artefacts, which allows him to continuously realize intentions by means of these extensions. This also contributes to the convenience and efficiency of realizing these intentions, as one does not have to shift between different artefacts or locations to realize intentions; he or she has all these opportunities on his lap or in the palm of his hand.

Also concerning the distinction between individual, shared and organizational extensions (as made in chapter 2.3), contemporary information technology can provide many kinds of extensions simultaneously. Today, each of these kinds of extension can be provided by the same device. In the third chapter I concluded this after investigating the 'teleological dimension', showing that information technology initially was mainly an organizational extension, later also an individual one and due to the internet also a shared extension became possible. A consequence that today's information technology can provide each of these extensions, is that it now plays an important role in almost all 'spheres of life': information technology is used or has a role in the practice of many jobs as an organizational extension, individuals use it to extend their minds and get involved with information and people use it together to communicate and use other abilities of the internet. Often even the same devices are used to add even more convenience to the user.

The accumulation of all these possibilities into single devices has contributed to the convenience and efficiency, as the user can access all these extensions everywhere and always. There are however important effects that we should investigate that affect the opportunities for those individuals to develop their selves and their capabilities. I will here focus on two main ways these characteristics of the extension of information technology affect the opportunities for the user to develop valuable faculties.

Consequence 1: Always demanding attention

Information technologies are not just passive extensions which are only used when the human reaches for them. They are active in that they continuously play a role in the background of our lives, and will on certain moments demand our attention. A text message, a mentioning in a social media post, a game invitation, they all demand our attention in a direct way. In this way, information technology can 'invade' a presence. When busy with something else, the user all of sudden for instance has to choose between continuing what he was doing, or seeing why his smartphone was vibrating. Brey (1997) called this the problem of *presence competition*. With the above discussed characteristics, we can understand that due to all these possible presences that contemporary information technology has lingering - those of social media, entertainment websites, dialogues with friends, video games etcetera - these continuously compete for our presence. In that competition, we might even forget that there is also an 'offline world' in which physical entities demand our attention.

Furthermore it is troubling that some presences are more dominant than others. Information technology especially is of such a dominant nature in the way it demands attention, which can cause other presences to be disturbed and 'invaded' (Brey, 1997). Not only does this force the person to 'step out' of the current presence, which could disturb an opportunity for development, also other people are left behind in their presence and do not receive attention anymore from the person turning to a digital presence. As such the way information technologies so easily extend the human to different presences, can limit valuable opportunities.

We see this problem especially in the context of being disturbed by work-related messages and calls during free time. For many occupations for instance, employees have to be reachable even when they are not on their work, via mobile phone, Skype or e-mail. This leads around half of the people (for people under 35 the percentage is much higher) to check their e-mail after work, during the weekend and on vacation (Brownawell and Wiggins 2013). But also the other way around, do many people at work use extensions to check-in with their personal life. Of people under 35, almost 75% of employees is for instance daily concerned with services such as Facebook, LinkedIn and Amazon during work time (Galely, Horton and Wrona 2015).

This is a consequence of today's technologies being used to realize individual, shared and organizational intentions all at once: we continuously carry devices that can extend us to all these different presences. With earlier technologies, this was not possible; one could not access a workbench, paper archive or colleagues when away for the weekend. Today's devices however make that a person can always be connected to his other 'presences' and as these invade each other, opportunities to develop important human faculties are frustrated.

It is in that way, being continuously (potentially) disturbed by another presence, that information technology can cause people to miss opportunities of focal practice and meaningful events by being extended by information technology and thereby leaving their immediate presence and the other people in it. The danger is that in the human's attempt to be extended to many presences at once, we get lost without any present with which we can actually engage. As Seneca (book I, ep. II) already wrote: "Nusquam est qui ubique est"; he who is everywhere is nowhere.

Information technologies make many different presences available. The first threat to flourishing is thus that opportunities for development are continuously disturbed by extensions of information technology demanding attention. I will here discuss a second relevant threat, namely that an important *conversion factor* can be frustrated: *focus*.

Consequence 2: Frustrating the ability to focus

With all these different extensions, information technology provides many possibilities, (micro-) activities, that are always on stand-by. Because of these opportunities to do, see and experience via information technologies, people often do not choose one specific application, but do everything at once. This is the problem of 'continuous partial attention'; constantly scanning for opportunities and staying on top of contacts, events, and activities in an effort to miss nothing (Stone 2008). Many users of information technology cannot find a way to meaningfully engage with all the different options available and therefore continuously shift between them (Rosen 2008). Contributory to this problem is the 'fear of

missing out', the "pervasive apprehension that others might be having rewarding experiences from which one is absent, FoMO is characterized by the desire to stay continually connected with what others are doing" (Przybylski, et al. 2013).

The ability to focus is an important conversion factor to be able to actually derive the meaning and opportunities a good provides. The extension of information technology frustrates this capability and thereby the ability to transform goods to valuable functionings. In *The Shallows: What the Internet Is Doing to Our Brains*, Nicholas Carr (2010) is concerned with problems of focus in the age of information technology. He there presents an alarming picture of the consequences of the internet and information technology in general to our ability to focus. The biggest threat is that the way users continuously device their attention, decreases our richness of thought, memories and even personality.

Neuropsychiatrist Eric Kandel (2006) points out that as one's ability to focus is affected, this also threatens the ability to retrieve and store memories: "For a memory to persist, the incoming information must be thoroughly and deeply processed. This is accomplished by attending to the information and associating it meaningfully and systematically with knowledge already well established in memory" (p.124). It is this thorough and deep processing that is at stake and by decreasing the human's ability to do so, information technology deteriorates the way we can transform valuable goods to meaningful functionings. Reading a book, watching (and finishing) a movie, writing a paper, all seem to become harder for children growing up, as they are continuously shifting their attention between all the other media that are available. With that it is also problematic that the general development for today's media is that everything has to be faster and faster, with less time to read and more different clips to watch. As Oxford Learning (2007), a major learning center, writes: "So these same kids who live a fast-moving, multiprocessing life are, on a daily basis, put in a classroom where they are expected to sit still and focus on a single thought, person, or image for a long stretch of time. That's a major downshift for the child. Is it any wonder that 70% of them are having difficulty staying on task, focusing, and paying attention?". Rosen (2008) sketches the picture of "pubescent multitasking mavens […] of a generation of great technical facility and intelligence but of extreme impatience, unsatisfied with slowness and uncomfortable with silence" (p.108).

As it becomes troublesome to thoroughly concentrate, also other faculties are affected because less opportunities are provided to develop them. Developmental psychologist Greenfield argues that while the possibilities of information technology strengthen our visual-spatial intelligence, which is for example beneficial for detailed surgery and piloting, it decreases 'higher-order cognitive processes', functionings such as "abstract vocabulary, mindfulness, reflection, inductive problem solving, critical thinking, and imagination" (Greenfield 2009).

Thus by the many opportunities information technology present, we do not actually choose one of those but continuously shift between them. Focus is an important conversion factor and its erosion hurts both the important human faculty itself and the possibility to develop other faculties such as reflection and problem-solving. One could argue that information technology does not force one to continuously choose between all these possibilities. However, I believe we can now understand that it is actually

inherent in the way information technology always provides all these possibilities, that the ability to focus and be present in one's environment is frustrated.

Conclusion: Consequences of the many extensions at once
The way contemporary information technology extends many sets of means at once has two detrimental effects on the opportunities for the human to develop himself. First, the abundance of stand-by extensions that information technology provides is troublesome because it requires us to choose between all these different 'presences'. Information technology has the tendency to dominate other presences because of the way it demands attention. In that way meaningful experiences - opportunities for development - can be disturbed. Thus although valuable goods might be available for the individual, information technology can quite literally disturb its beneficial effects. Second, the ability to focus, a personal conversion factor, is affected, which hurts the human's ability to transform certain goods into meaningful functionings. This also frustrates other capabilities concerned with learning and development of thought processes.

It is in these two general ways that this characteristic of the extension of information technology limits the opportunities to flourish; it hurts the development of essential mental, intellectual and moral faculties required for human excellence.

4.3 Conclusions of the assessment: Extension over flourishing

I have now evaluated the main characteristics of the extension of information technology, by analyzing their impact on the opportunities for the human being to develop himself. I have argued that while realizing intentions by means of the extension of information technology is very convenient and efficient, its characteristics show a tendency to frustrate opportunities to develop oneself as a human; because it disturbs valuable *situations*, replaces other important *means* or because it directly affects such human *faculties* (i.e. the body and the ability to focus).

In figure 3, these conclusions are shown in the capability approach. Information technology is often valued as a good (1), but there are two main effects (2, 3) that can frustrate the achievement of valuable functionings. I will discuss these three effects below.

1: Information technology is a very convenient and efficient good
During the analysis it became more and more clear that information technology is a very efficient and convenient extension of means to realize intentions. It overcomes the human's natural limitations, can be used to realize many intentions with the same device and is able to realize many different kinds of intentions. In this way it is a good that creates capabilities to achieve functionings much easier than with the human's natural means or with alternative objects. That it could and should be questioned whether these functionings contribute to the human flourishing was shown in this chapter.

2: Information technology overshadows and disturbs alternative goods
While information technologies do not literally decrease the amount of other goods, they work so efficiently as an extension to realize intentions that they can overshadow alternative means to realize those intentions. These alternative means might have led to valuable functionings, focal events that information technology does not afford, because it was not incorporated into the technology, or because

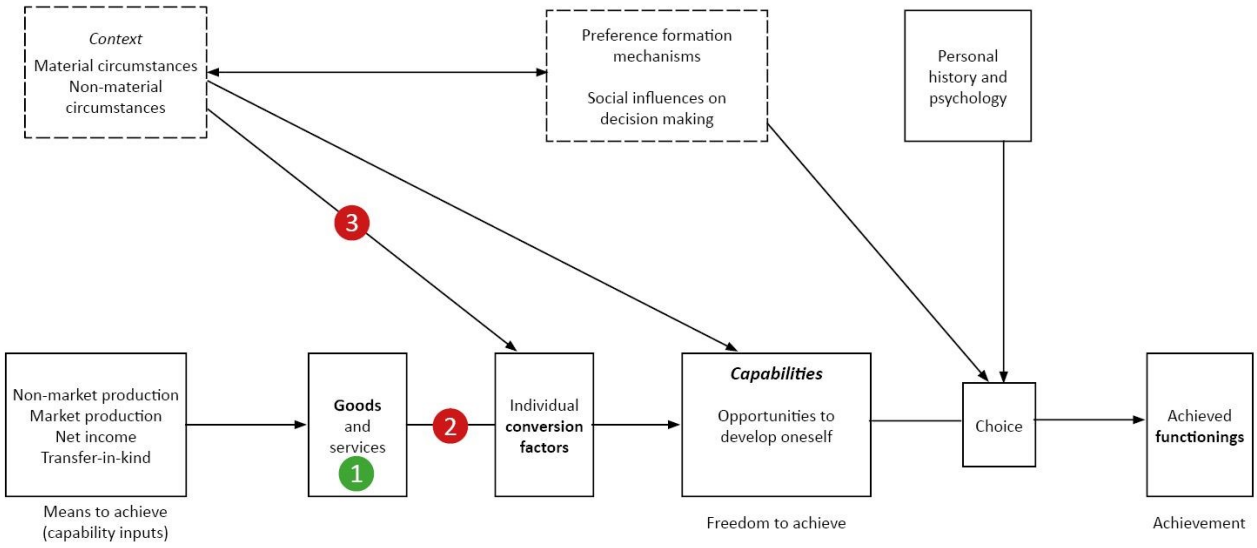

Figure 3: The relation between goods, functionings and capability, with the effects depicted of the extension of information technology

some elements in the world cannot be digitally extended. Furthermore, information technologies have the tendency to disturb and distract from meaningful activities that do take place because of the way they demand attention. In this way, valuable situations and means that would normally provide opportunities for development are frustrated by the extension of information technology.

3: Information technology frustrates important conversion factors

The extension of information technologies frustrates two important conversion factors and thereby limits the translation of goods into valuable capabilities. First, the conversion factors of the body are frustrated because virtually the whole body is extended and because it becomes an inferior alternative to technological means. Second, the ability to focus is impacted as information technologies continuously extend the human to many different stand-by presences, which many users rapidly shift between without being able to focus on only the most valuable ones. In this way, important faculties that support the development of the human self are frustrated by the extension of information technology.

Conclusion

By means of these conclusions, it is clear that information technology propagates ever increasing efficiency and convenience to realize intentions, but that it can thereby frustrate the human's opportunities to flourish. These are very serious effects: the human loses its ability to develop bodily faculties, to focus and to be involved in situations that require him to further develop his abilities. The danger that awaits seems to be the human becoming a being accustomed only to commodities to realize each and every intention, a bodily-less creature that finds no rest and is continuously searching for meaning in the empty hyper reality that are the extensions of information technology; there is no need to develop any faculty himself as information technology extends each means with a more efficient and convenient way to realize the intention.

4.4 Light in the darkness: Extension as enabler

It has become clear that information technology is both an extremely efficient and convenient means to realize intentions but contains also a serious threat for the human's ability to flourish. There is an imminent danger that these negative effects will get the upper hand, if they do not already have. Not in all situations this danger might however be present: While above conclusions are derived from the way information technology extends valuable sets of means, many humans do not have access to these means in the first place. If one does not have access to valuable situations, means and faculties that create opportunities for development, there seems to be nothing to disturb or frustrate. I will develop this argument in this section to show how the situation of the individual concerning the means he has access to can determine to which extent information technology frustrates his flourishing and that in certain situations information technology might actually provide such opportunities.

Extending human faculties

I discussed how the extension of information technology affects the relation with the body and can thereby limit important bodily faculties. However for some people, these bodily faculties are already severely limited; obvious examples concern the various physical handicaps people can have. For these people, information technologies can provide an extension to their mind that they otherwise would not have access to. In this way, capabilities are created that allow them to realize intentions. Examples include the ability to do shopping, stay in touch with other human beings, participate in certain events etcetera. These functionings can become available to people by means of the extension of information technology, whereas their natural capabilities might be deficient.

Computers can in these cases also play the role of a more literal extension of the mind in order to provide capabilities. People who have impaired speech, sight or hearing have in this way experienced many benefits of the computer. It allows them to access mainstream media without having to rely on the help of others and can also further assist them in daily life, for instance as a communication device. This led Sussman in 1996 already to state that "[c]omputers help give disabled people what they want more than anything else: independence." With that also "comes the capability for even severely disabled people to earn a living".

Especially for people that are housebound, either temporarily or chronically, due to other conditions such as psychical diseases (dementia but also for instance agoraphobia) or loss of mobility due to old age, information technology can be an aid to develop oneself. A couple of decades ago it was very hard for these people to be able to participate in society due to restricted means of communication and social life and because they had to rely on others for their shopping. Information technology however has empowered them by providing an extension which allows them to realize many of such intentions digitally (Nahm and Resnick 2001). The internet especially can provide means for banking, shopping, attending social gatherings, and in this way can provide housebound people with functionings concerning autonomy and social life. They can achieve functionings that would otherwise have remained unfulfilled and find means to develop their faculties, with access to education and social interaction. Dreyfus (2009) for instance describes how the communication media of the internet such as e-mail and online meeting places provide 'isolated souls' with means to engage in a social life and to find 'kindred

souls' to relate to. Also developments such as telehealth care has increased capabilities for human beings that otherwise would not be able to stay at home.

Thus, regarding the capability approach, by means of the extension of information technology, people without the right personal *conversion factors*, concerning body and mind, can achieve valuable functionings (see figure 4, circle 4). As the extension of information technology can provide an alternative, they could thereby get access to situations with valuable opportunities for the human development.

Extending situations and means

The demographic sketched above lacks capabilities *inherently*, which information technology can provide as an alternative, enabling them to realize intentions. But not only inherent deficiencies can be a reason that information technology enables capabilities. Also not having access to *external* means, can limit one from having the capabilities. In these cases the *capability inputs* are missing.

Again here, information technology can, as a good, make these capabilities available and thus compensate the lacking capability inputs. Many people in the world for instance do not have access to proper education or have books and interesting videos to their disposal. This can be because they do not have the financial means, because they do not have these in their vicinity or because they lack the time, occupied for instance by supporting a family. By means of the material extension, information technology can provide these means, such as online courses, digital books and videos on-demand, and people can find here opportunities to develop oneself that they have otherwise no access to. Also individuals who are not directly housebound, but are very immobile because they for instance have children at home and cannot afford a babysitter, are by means of modern information technology able to achieve functionings. They are for instance able to attend online education and to maintain more of a social life.

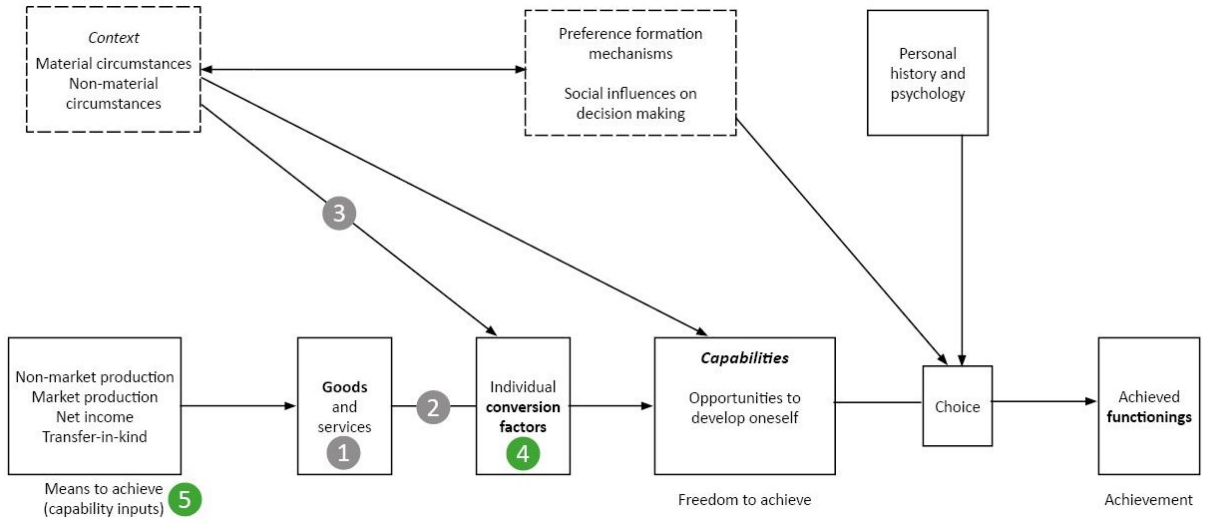

Figure 4: The relation between goods, functionings and capability, with the effects depicted of the extension of information technology for humans without access to appropriate capability inputs or conversion factors

Thus, regarding the capability approach, by means of the extension of information technology, people without the right *capability inputs* can achieve valuable functionings (see figure 4, circle 5). As the extension of information technology can provide an alternative, they could thereby get access to means that can generate valuable opportunities for the human development.

The relevance of the individual

With the above examples I intend to show that while the extension of information technology can limit many opportunities to flourish, for some people these opportunities would not have been there in the first place. In those cases information technology extends, as it were, a 'null set'; the set that is extended is empty and thus there is nothing to disturb. Instead, the extension of information technology enables the achievement of these functionings in the first place.

The conclusions concerning information technology that were established with the perfectionism-grounded capability approach thus seem to apply most directly to those who have sufficient access to the right opportunities; opportunities to develop their corporeal, mental, intellectual and moral faculties, which require the right situations, means and faculties to be in place. Thus while the dark conclusions are valid for healthy individuals in well-developed areas, they might not be for individuals with other characteristics; for these people information technology can actually contribute to their flourishing, as it can create opportunities to develop their faculties.

4.5 Conclusion

In this chapter the extension account of the third chapter was evaluated. First, a normative approach had to be developed for this analysis, which could answer the first question:

3.1 *How can the impact of the extension of information technology on the flourishing of the human being be analyzed?*

After discussing why subjective approaches and objective lists were not appropriate for the analysis of the extension of information technology, I argued that William Hamilton's definition of perfection provides a very interesting basis for the concept of flourishing: "the full and harmonious development of all our faculties, corporeal and mental, intellectual and moral". Perfectionist approaches are however often accused of an elitist understanding of what the best life is. To refute this claim for the analysis at hand, I introduced the capability approach within which the perfectionist understanding of flourishing can provide a good basis. With this capability approach, it becomes possible to question how the opportunities to fully and harmoniously develop all human faculties are affected. With the concepts of goods, conversion factors, capabilities and functionings it also provides a framework to analyze how the extension of information technology impacts these opportunities for the human being.

With this approach, an answer to the second subquestion could be developed:

3.2 *In which general ways is the flourishing of the human individual affected by the extension of information technology?*

The basis for this analysis was provided by the tree main characteristics of the extension of information technology that emerged from the third chapter. These concern that to realize intentions (1), contemporary information technology extends cognitive faculties, material objects, the world and the mind (2). In a tight coupling, it can extend these sets of means all at once and realize intentions on an individual, shared or organizational level (3).

It became clear that each of these characteristics adds to the way information technology provides a very efficient and convenient means to realize intentions. I however also showed that each of these characteristics by its nature negatively affects the opportunities for the individual human to flourish: by its efficiency and convenience information technology can form a dominate substitute to more valuable means in terms of human development; by its mind-focus it can disturb important human conversion factors of the body; and because all these extensions are always lingering, it can interfere with valuable opportunities and can frustrate the conversion factor of focus and attention. It is in these general ways that the flourishing of the human being is affected by the extension of information technology.

The extension of information technology thus enables the human to realize intentions very efficient and convenient, but it comes with the price that many opportunities to flourish are cut short because situations, means and faculties are frustrated that these opportunities require. I then added to these conclusions that not every human might have access to these situations, means and faculties in the first place. People might naturally lack certain faculties as conversion factors or people might not have the right capability inputs to acquire those means. It is in those situations that the extension of information technology might actually provide more opportunities for the human being to develop himself.

To summarize, it is clear that the extension of information technology negatively affects the flourishing for those individuals who have sufficient access to both inherent and external means to realize intentions. Other individuals might lack these and for them information technology might actually be a valuable extension to get access to such situations. This leaves us with quite a cynical conclusion, as it seems that the ones who have access most to information technology are generally not short on other means to realize intentions, while the ones without access - the poor, handicapped or remote - do not. I will further consider this conclusion and answer the main research question of this thesis in the next and final chapter.

Chapter 5: Conclusion

In the previous three chapters, I have developed an answer to each of the subquestions formulated in the introductory chapter. I will here first shortly summarize these answers in order to conclude with an answer to the main question of this thesis. Subsequently, this will lead me to make suggestions for future research.

5.1 Summary and answer to the main question

The main research question of this thesis was:

> *"How can information technology be understood as an extension and in which general ways is the flourishing of the human individual affected by this extension?"*

To answer this question, first an appropriate extension theory of technology had to be established. In the second chapter, this theory proved to be an adaption of Brey's (2000) extension thesis: *"All artifacts extend a set of naturally given means by which human intentions are realized"*. By means of this thesis and a further exploration of it, the development of information technology as an extension could be analyzed. In the third chapter, four main stages were distinguished and in each stage it was investigated what information technology extends and on which level (i.e. individual, shared or organizational) intentions are realized. The first stage for analysis concerned the early computers (from late 19th century onwards). It was found that computers initially extended cognitive faculties such as calculative abilities and memory, in order to realize organizational intentions. Around the 1970s, in the second stage, computers also became available for individuals themselves to realize their own intentions. Developments in the field meanwhile led to the possibility to not just extend the human cognitive faculties, but also parts of the world, in a material extension.

Next, the development of the World Wide Web in the 1990s was an important step for the understanding of information technology as an extension. Extension of objects could now be updated real-time, enabling the extension of media such as newspapers, television and radio possible. Also locations and human interaction became extended. In this way, by interconnecting human beings across the planet, information technology was able to extend many new sets of means; so many means, that the world itself has become extended, with the internet's search function as an extremely efficient infrastructure. Furthermore, information technology could now be used to simultaneously realize shared intentions, in addition to organizational an individual extension already integrated into the daily realization of many intentions.

The final relevant development of information technology was to become (conveniently) portable, most notably in the form of the smartphone. This development enabled information technology to become an extension of the mind, being a reliably coupled artefact. Due to this portability, information technology also emerged more and more as a personal and individual extension and could be seen as an extension of the self.

With this extension account of information technology, I developed an understanding of its normative implications in the fourth chapter. I first established that a capability approach with perfectionist grounding would be an appropriate and fruitful approach. By taking the flourishing of the human

individual as basis, defined as “the opportunity to fully and harmoniously develop all human faculties”, the main conclusions of the third chapter could be analyzed. This led to the following observations:

1. By means of the extension of information technology, many intentions can be realized very efficiently and conveniently. The way information technology in this way realizes intentions as a commodity is however detrimental to other means to realize those intentions, which could have generated opportunities for development.
2. The cognitive and material extensions of information technology overcome limitations of the means that are extended, by which especially the body is disburdened. This can however negatively affect bodily faculties and frustrate opportunities to develop these and related faculties. These negative effects are increased as the body itself starts to be regarded as ‘just’ another extension.
3. Information technology can extend many sets of means, by which it gives the human access to many different ‘presences’ at once. Because all these presences are continuously at hand, they can invade other presences and thereby disturb valuable opportunities. Furthermore it is troublesome that many users of information technology continuously give partial attention to all these possibilities, which limits their ability to focus on one thing and can also frustrate other related faculties, such as memory and the richness of thought.

While today’s information technologies thus improve the efficiency and convenience to realize intentions, the inherent detrimental effects on human flourishing are troublesome. The extensions limit important opportunities for the individual to develop himself and frustrate valuable faculties directly. I then observed that not in all situations individuals have access to these opportunities in the first place. If one does not have access to means, locations and faculties that enable fruitful opportunities, there is nothing for information technology to disturb or frustrate. In such cases, information technology could even provide such opportunities by extending the mind and material means. Knowledge about the means an individual has access to in the first place – internal and external – is thus required for an understanding of how information technology affects the opportunities for the individual to develop himself in specific situations.

These observations and conclusions lead to the following final answer to the main research question of this thesis: Information technology can be understood as an extension of the human being, by extending his cognitive faculties and his mind, and as an extension of the world by means of material extension and the extension of locations and interaction. This is fundamentally different from earlier technological artefacts, that were related to the extension of bodily and sensory faculties. The effects of these revolutionary extensions of today’s information technology critically depend on the means and faculties present in a situation: In situations where opportunities for development are a given, information technology frustrates the individual flourishing in general ways which concern the frustration of these valuable means, situations and faculties. In situations where opportunities for development are lacking, information technology could extend both internal and external means and in that way create valuable opportunities and contribute to the flourishing of the individual.

5.2 Suggestions for future research

The approach, findings and conclusions of this thesis give rise to a few interesting subsequent issues that would be worthwhile to investigate:

First, while extension theory has been out of 'fashion' for quite a while, I showed that it is still very valuable as a way to understand technology and how it affects the human being. By means of this basis and subsequently involving other authors, I was able to discover crucial characterizing features of information technology and their effects. A fascinating follow-up on this thesis would the also be to consider future (information) technological developments and understand these as extensions. Developments such as 'ambient intelligence' for instance, or the 'internet of things' that can connect devices as to make technology disappear into the surroundings (Heersmink, Hoven and Timmermans, Normative Issues Report n.d.) would be interesting to study. Can these developments be understood as extensions and if so, how? Are they perhaps a new kind of material extension that is not a simulation, but an extension of the world on itself? Other developments such as virtual reality and neuro-electronics would also make interesting cases to try to grasp what these are and do, by means of an extension account of technology.

Second, in the fourth chapter I analyzed the effects of the extension of information technology. Due to scope, it was not possible to encompass every single effect and I used a capability approach with perfectionist grounding as basis for analysis. This showed some vital ways in which information technology affects the human flourishing. Other approaches might however approach these issues in other ways and for instance reveal effects concerning freedom, social dynamics, politics or more specific issues, such as warfare or children's development. One could also focus on more specific aspects of information technology, such as social media and video games, or artefacts such as the tablet or smartwatch.

Third, from the normative conclusions developed in this thesis some questions arose that are quite urgent concerning the effect on flourishing. It became clear that while information technology can be used to realize intentions that could not have been realized before, in affluent countries it frustrates the human flourishing. Should we thus abandon information technology altogether in these most developed parts of the world? Even if this were our conclusion, it would realistically not be possible taking account just how big of a role information technology plays today. It would therefore be worthwhile to establish how the negative effects of information technology can (at least) be mitigated. Efforts could be undertaken to for instance make information technology less of a disturbing factor and to incorporate the body more in computer processes, which seem especially relevant for the generation now growing up as 'natives' of a digital world. For new technologies it is urgent to investigate these effects, in order to understand whether these provide the positive opportunities of information technology - when it does not disturb other means but actually provides new means to realize intentions that could never have been realized before - or whether the future will see an even more 'commodified' society - where shallow realization of intentions prevails but actual human flourishing suffers. We should use these insights to realize a world in which the extended human is one seizing the opportunities to flourish, not one in which the many extensions have already cut these opportunities short.

Bibliography

Adams, Fred, and Ken Aizawa. "Defending the bounds of cognition." *The Extended Mind*, 2010: 67-80.

Alexa. "The top 500 sites on the web." *Alexa.* 2015. http://www.alexa.com/topsites (accessed April 20, 2015).

Allen-Hermanson, Sean. "Superdupersizing the mind: extended cognition and the persistence of cognitive bloat." *Philosophical Studies*, 2012: 791-806.

Applegate, Lynda M., James I. Cash, and Jr.D. Quinn Mills. "Information Technology and Tomorrow's Manager." *Harvard Business Review*, 1988.

Austin, J.L. *Sense and Sensibilia.* Oxford: Oxford University Press, 1962.

Aydin, Ciano. "The artifactual mind: overcoming the 'inside–outside' dualism in the extended mind thesis and recognizing the technological dimension of cognition." *Phenom Cogn Sci*, 2013: 1-22.

Banks, Jerry. "Introduction to Simulation." *Winter Simulation Conference.* Atlanta, 2000. 9-16.

Belk, Russell W. "Extended Self in a Digital World." *Journal of Consumer Research*, 2013: 478-500.

Belk, Russell W. "Possessions and the Extended Self." *Journal of Consumer Research*, 1988: 139-168.

Borgmann, A. *Holding On to Reality: The Nature of Information at the Turn of the Millennium.* University Of Chicago Press, 1999.

Borgmann, Albert. *Technology and the Character of Contemporary Life.* Chicago/London: University of Chicago Press, 1984.

Brey, Philip. "Extending Minds and Simulating Worlds: Functional and Phenomenal Roles of." In *Current Issues in Computing and Philosophy*, by A. Briggle, P. Brey and K. Waelbers. IOS Press, 2008.

Brey, Philip. "New Media and the Quality of Life." *Techné: Journal of the Society for Philosophy and Technology*, 1997: 1-23.

Brey, Philip. "The Epistemology and Ontology of Human-Computer Interaction." *Minds and Machines*, 2005: 383-398.

Brey, Philip. "The social ontology of virtual environments." *American Journal of Economics and Sociology*, 2003: 269-282.

Brey, Philip. "Theories of Technology as Extension of Human Faculties." In *Metaphysics, Epistemology, and Technology. Research in Philosophy and Technology, vol 19*, by C. Mitham. London: Elsevier/JAI Press, 2000.

Brooks, Elizabeth, Spero M. Manson, Byron Bair, Nancy Dailey, and Jay H. Shore. "The Diffusion of Telehealth in Rural American Indian Communities: A Retrospective Survey of Key Stakeholders." *Telemedicine Journal and e-Health*, 2012: 60-66.

Brownawell, Angel, and Katelynn Wiggins. "Americans Stay Connected to Work on Weekends, Vacation and Even When Out Sick." *American Psychological Association.* September 4, 2013. http://www.apa.org/news/press/releases/2013/09/connected-work.aspx (accessed July 19, 2015).

Clark, Andy. "Coupling, Constitution and the Cognitive Kind: A Reply to Adam and Aizawa." 2006: 1-36.

—. *Supersizing the Mind: Embodiment, Action and Cognitive Extension.* New York, NY: Oxford University Press, 2008.

Clark, Andy, and David J. Chalmers. "The Extended Mind." *Analysis*, 1998: 10-23.

Clark, David A. *The Capability Approach: Its Development, Critiques and Recent Advances.* Global Poverty Research Group, 2005.

Clayton, Russell B., Glenn Leshner, and Anthony Almond. "The Extended iSelf: The Impact of iPhone Separation on Cognition, Emotion, and Physiology." *Journal of Computer-Mediated Communication*, 2015: 1-17.

Crisp, Roger. "Well-Being." *The Stanford Encyclopedia of Philosophy (Winter 2014 Edition), Edward N. Zalta (ed.).* 2014. http://plato.stanford.edu/archives/win2014/entries/well-being/ (accessed April 20, 2015).

Deci, Edward L., and Richard M. Ryan. "Hedonia, Eudaimonia, and Well-Being: An Introduction." *Journal of Happiness Studies*, 2008: 1-11.

Dreyfus, Hubert L. *On the Internet.* New York, NY: Routledge, 2001.

Edward McAuley, Bryan Blissmer, David X. Marquez, Gerald J. Jerome, Arthur F. Kramer, Jeffrey Katula. "Social Relations, Physical Activity, and Well-Being in Older Adults." *Preventive Medicine*, 2000: 608-817.

Fallman, Daniel. "A different way of seeing: Albert Borgmann's philosophy of technology and human-computer interaction." *AI & Soc*, 2010: 53-60.

Finnis, John. *Natural Law and Natural Rights.* Oxford University Press: New York, 1980.

Freund, Peter. *The Civilized Body: Social Domination, Control and Health.* Philedelphia: Temple University Press, 1982.

Galely, Lubaina, Anthony Horton, and Whitney Wrona. *R U Ready 4 Y?* Xlibris, 2015.

Gallagher, Shaun. "The Socially Extended Mind." *Cognitive Systems Research 25*, 2013: 4-12.

Gehlen, Arnold. *Der Mensch. Seine Natur und seine Stellung in der Welt.* 1940.

Greenfield, Patricia M. "Technology and Information Education: What is Taught, What Is Learned." *Science*, 2009: 69-71.

Griffin, James. *Well-Being: Its Meaning, Measurement , and Moral Importance.* 1988.

Hamilton, Sir WIlliam. *Metaphysics and Logic.* Boston: Gould and Lincoln, 1859.

Hanman, Natalie. "Who should be Time magazine's person of 2012?" *The Guardian.* November 28, 2012. http://www.theguardian.com/commentisfree/2012/nov/28/time-magazine-person-2012 (accessed October 26, 2015).

Hassmén, Peter, Nathalie Koivula, and Antti Uutela. "Physical Exercise and Psychological Well-Being: A Population Study in Finland." *Preventive Medicine*, 2000: 17-25.

Hayles, N. Kartherine. *How we became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics.* Chicago and London: The University of Chicago Press, 1999.

Heersmink, Richard. "A Taxonomy of Cognitive Artifacts: Function, Information, and Categories." *Review of Philosophy and Psychology*, 2013: 1-17.

Heersmink, Richard. "Defending extension theory: A response to Kiran and Verbeek." *Philosophy & Technology*, 2012: 121-128.

Heersmink, Richard. "Dimensions of integration in embedded and extended cognitive systems." *Phenom Cogn Sci*, 2014: 1-22.

Heersmink, Richard, Jeroen van den Hoven, and Job Timmermans. *Normative Issues Report.* ETICA, n.d.

Hogenová, Anna. "The corporeal schema and health problems." *Gymnica*, 2000: 7-11.

Howard, Philip N., Aiden Duffy, Deen Freelon, Muzammil M. Hussain, Will Mari, and Marwa Maziad. *Opening Closed Regimes: What Was the Role of Social Media During the Arab Spring?* Washington: Project on Information Technology & Political Islam, 2011.

Humboldt, Wilhelm von. *The Limits of State Action.* Cambridge: Cambridge University Press, 1969.

Hurka, Thomas. *The Best Things in Life.* Oxford New York: Oxford University Press, 2011.

Ihde, Don. "Bodies in Technology." 3-15. Minneapolis: University of Minnesoate Press, 2002.

—. *Technology and the lifeworld.* Bloomington: Indiana University Press, 1990.

Internet Live Stats. *Internet Live Stats.* 2015. http://www.internetlivestats.com/ (accessed September 29, 2015).

Jacobs, Ian. "25 things you probably didn't know about the Web." *Web 25 Anniversary.* March 12, 2014. http://www.webat25.org/news/webfacts (accessed April 20, 2015).

Johnstone, Justine. "Capabilities and Technology." In *The Good Life in a Technological Age*, by Philip Brey, Adam Briggle and Edward Spence, 77-91. New York, NY: Routledge, 2012.

K.Przybylski, Andrew, Kou Murayama, Cody R.DeHaan, and Valerie Gladwell. "Motivational, emotional, and behavioral correlates of fear of missing out." *Computers in Human Behavior*, 2013: 1841-1848.

Kandel, Eric. *In Search of Memory: The emergence of a new science of mind.* WW Norton & Company, 2006.

Kapp, Ernst. *Grundlinien einer Philosophie der Technik.* 1877.

Kiran, Asle H, and Peter-Paul Verbeek. "Trusting our selves to technology." *Knowledge, Technology & Policy*, 2010: 409-427.

Lane, Edwin. "How technology is changing disaster relief." *BBC News.* September 24, 2014. http://www.bbc.com/news/technology-29149221 (accessed July 19, 2015).

Lawson, Clive. "Technology and the Extension of Human Capabilities." *Journal for the Theory of Social Behaviour*, 2010: 207-223.

Leavitt, Harold J., and Thomas L. Whisler. "Management in the 1980's." *Harvard Business Review*, 1958.

Leiner, Barry M., et al. *Brief History of the Internet.* Internet Society 20 Years, 2012.

Liang, Ting-Peng, Jun-Jer You, and Chih-Chung Liu. "A resource-based perspective on information technology andfirm performance: a meta analysis ." *IMDS*, 2010: 1138-1156.

Locker, Melissa. "IKEA Is Getting Into the Wedding Business." *Time.* April 14, 2015. http://time.com/3821008/ikea-virtual-wedding-service/ (accessed October 27, 2015).

Marchionini, Gary. *Information Seeking in Electronic Environments.* Cambridge: Cambride University Press, 1995.

Martin, Bradford D., and Ernest Schwab. "Current Usage of Symbiosis and Associated Terminology ." *International Journal of Biology*, 2013: 32-45.

McLuhan, Marshall. *Understanding Media: The Extensions of Man.* New York, NY: The New American Library, Inc., 1964.

Meeker, Mary, and Liang Wu. *2013 Internet Trends.* USA: KPCB, 2013.

Merleau-Ponty, M. *Phenomenology of perception.* London: Routledge, 2003.

Mooradian, Norman. "Virtual Reality, Ontology, And Value." *Metaphilosophy*, 2006: 673-690.

Moore, Andrew. "Hedonism." *The Stanford Encyclopedia of Philosophy.* Winter 2013. http://plato.stanford.edu/archives/win2013/entries/hedonism/ (accessed October 27, 2014).

Nahm, Eun-Shim, and Barbara Resnick. "Homebound Older Adults' Experiences with the Internet and E-mail." *Computers in Nursing*, 2001: 257–263.

Norman, Donald A. "Cognitive Artifacts." In *Designing Interaction: Psychology at the Human-Computer Interface*, by J.M. Carroll, 17-38. Cambridge: Cambridge University Press, 1991.

Nussbaum, Martha. *Creating Capabilities: The Human Development Approach.* Cambridge: The Belknap Press of Harvard University Press, 2011.

O'Regan, Gerard. *A Brief History of Computing second edition.* London: Springer, 2012.

Ören, Tuncer. "Advances in Computer and Information Sciences: From Abacus to Holonic Agents." *Turkish Journal of Electrical Engineering and Computer*, 2001: 63-70.

Oxford Learning. "Why can't kids concentrate?" *Oxford Learning.* February 16, 2007. http://www.oxfordlearning.com/2007/02/16/why-cant-kids-concentrate/ (accessed September 3, 2015).

Parfit, Derek. *Reasons and Persons.* Oxford, 1984.

Pew Research Center. *U.S. Smartphone Use in 2015.* Washington, DC: Pew Research Center, 2015.

Pinch, Trevor J., and Wiebe E. Bijker. "The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other." *Common Themes*, 1984: 17-48.

Przybylski, Andrew K., Kou Murayama, Cody R. DeHaan, and Valerie Gladwell. "Motivational, emotional, and behavioral correlates of fear of missing out." *Computers in Human Behavior*, 2013: 1841–1848.

Rawls, John. *A Theory of Justice: Revised Edition.* Cambridge, MA: Harvard University Press, 1971.

Roberson Museum and Science Center. *The Link Flight Trainer: A Historic Mechanical Engineering Landmark.* Birmingham: ASME International, 2000.

Robeyns, Ingrid. "Sen's Capability Approach and Gender Inequality: Selecting Relevant Capabilities." *Feminist Economics*, 2011: 61-92.

Robeyns, Ingrid. "Sen's Capability Approach and Gender Inequality: Selecting Relevant Capabilities." *Feminist Economics*, 2011: 61-92.

Robeyns, Ingrid. "The Capability Approach: A Theoretical Survey." *Journal of Human Development*, 2005: 93-114.

Rosen, Christine. "The Myth of Multitasking." *The New Atlantis*, 2008: 105-110.

Ross, David. *The Right and the Good.* New York: Oxford University Press, 1930, 2002.

Rothenberg, David. *Hand's End: Technology and the Limits of Nature.* Berkeley, CA: University of California Press, 1993.

Rothman, Lily. "How Person of the Year was Born." *TIME.* December 10, 2014. http://time.com/time-person-of-the-year-history/ (accessed October 26, 2015).

Schweikard, David P., and Hans Bernhard Schmid. "Collective Intentionality." *The Stanford Encyclopedia of Philosophy (Summer 2013 Edition).* 2013. http://plato.stanford.edu/archives/sum2013/entries/collective-intentionality/.

Searle, John R. *The Construction of Social Reality.* New York, NY: The Free Press, 1995.

Seligman, Martin E. P., and Ed Royzman. "Happiness: The Three Traditional Theories." *Authentic Happiness.* 2003. https://www.authentichappiness.sas.upenn.edu/newsletters/authentichappiness/happiness (accessed October 2, 2015).

Sen, Amartya. *Inequality Reexamined.* Oxford: Oxford University Press, 1992.

Shamberg, Michael. "Computers." *Time Magazine*, January 30, 1970: 49-50.

Shilling, Chris. *The Body and Social Theory.* London: Sage Publications, 1993.

Sloan, Bernie. "Twenty Years of Virtual Reference." *Internet Reference Services Quarterly*, 2006: 91-95.

Søraker, Johnny Hartz. "How shall i compare thee? Comparing the prudential value of actual and virtual friendship." *Ethics Inf Technol*, 2012: 209-219.

Steinert, Steffen. "Taking Stock of Extension Theory of Technology." *Philos. Technol.*, 2015: 1-18.

Stiroh, Kevin J. "Reassessing the Impact of IT in the Production Function: A Meta-Analysis and Sensitivity Tests." *Annales d'Économie et de Statistique*, 2005: 529-561.

Stone, Linda. "Continuous Partial Attention." *Linda Stone.* 2008. http://lindastone.net/qa/continuous-partial-attention/ (accessed July 19, 2015).

Sussman, Vic. *Opening Doors to an Inaccessible World.* 1994.

Swan, Melanie. "Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0." *J. Sens. Actuator Netw.*, 2012: 217-253.

Tanenbaum, Andrew S., and Todd Austin. *Structured Computer Organization Sixth Edition.* Boston: Pearson, 2013.

Tuomela, Raimo. *The Philosophy of Sociality.* New York: Oxford University Press, 2010.

Tupa, Anton. "Desire-Satisfactionism and Technology." In *The Good Life in a Technological Age*, by Adam Briggle, Edward Spence Philip Brey, 131-146. New York: Routledge, 2012.

Turkle, S. *Life on the Screen. Identity in the Age of the Internet.* Simon & Schuster, 1995.

U.S. Department of Commerce. "Tabulation and Processing." *United States Census Bureau.* March 31, 2015. http://www.census.gov/history/www/innovations/technology/tabulation_and_processing.html (accessed July 3, 2015).

United States Census Bureau. "Census Bureau's American Community Survey Provides New State and Local Income, Poverty, Health Insurance Statistics." *United States Census Bureau.* September 18, 2014. http://www.census.gov/newsroom/press-releases/2014/cb14-170.html (accessed September 29, 2015).

Varelius, J. "Objective Explanations of Individual Well-Being." *Journal of Happiness Studies*, 2004: 73–91.

Verbeek, Peter-Paul. "Devices of Engagement: On Borgmann's Philosophy of Information and Technology." *Techné: Research in Philosophy and Technology*, 2007.

—. *What Things Do.* University Park, PA: The Pennsylvania State University Press, 2005.

Vincent, Jane. "Emotional Attachment and Mobile Phones ." *Knowledge, Technology, & Policy*, 2006: 39-44.

Wadhwa, Manish, and Alan Harper. *Technology, Innovation and Enterprise Transformation.* Hershey: IGI Global, 2015.

Weinschenk, Susan. "Why We're All Addicted to Texts, Twitter and Google." *Psychology Today.* September 11, 2012. https://www.psychologytoday.com/blog/brain-wise/201209/why-were-all-addicted-texts-twitter-and-google (accessed September 2, 2015).

Winsberg, Eric. "Computer Simulations in Science." *The Stanford Encyclopedia of Philosophy (Summer 2015 Edition).* 2015. http://plato.stanford.edu/archives/sum2015/entries/simulations-science/.