Willing Technology

Inheriting understanding and practice in a complex technological system of dialysis treatment
Abstract
This thesis was originally motivated by a curiosity about how historicity and culture forms understanding in activities in a work situation. I wanted to gather and structure some thoughts about what happens when scientific, formally educated, knowledge, which dominates in a traditional desk learning situation, is facing knowledge which is learned through practice in real work situations with complex technology.

These contradictions, I believe, must be something we all experience every day, more or less consciously. A study could perhaps be done at any kind of activity or work. I chose a dialysis department and the work of dialysis nurses as an example. This turned out to be a good choice, since these two perspectives of understanding becomes quite clear in a setting with new technology, which, together with routines and treatment, is developing and changing constantly. Patients, nurses, doctors, patient wards, dialysis machines, water cleansing system, and so forth create a complex system. It is not possible to analyse this system, or even create anything meaningful for it, unless bringing in a perspective of time and culture, into the discussion. Historicity explains and forms work practice at the very same time, when the nurses have to create a standpoint and an understanding for the actions they have to take.

Creating meaningful design into complex environments is not helped by aiming for a total understanding of the whole system. Instead, agents that form the change of understanding, behaviour and action may work as keys into the creation of new design.

Acknowledgements
A lot of thanks to the two dialysis departments at the county hospital of Blekinge, and to all the nurses that made my study interesting and learning.

Thank you colleagues and fellow students that have cheered me on the way to the end.

And last but not least I want to address my great gratitude towards my close friend, who is a dialysis nurse and who has taken her free time to patiently answer rows of questions about dialysis treatment.
Some facts about the author

Before entering the study program People, Computers & Work, I had already tried two different careers. For seven years I studied archaeology at the University of Lund and have worked as an archaeologist at different sites in Northern Europe. The excavations have been concerning all historical periods from early Stone Age to late medieval times and newer times.

New paths in my life lead to four years as a composer at a free theatre ensemble and also as a music pedagogue working with school children and concerts.

The work was always free lance and I decided to try a new career by studying for four years at the PCW-program at Blekinge Institute of Technology in Ronneby.

Perhaps this could be seen as moving between two opposites, but actually, while writing this thesis it has come obvious to me that my thoughts about technology, culture, and use have taken their perspective in the discipline of archaeology and anthropology. Just as my thoughts about design as an activity originates from my own experiences of creating and performing music.

The two disciplines of ethnography and computer science, which form the base of the study program, I found have a great deal to learn from disciplines that treat culture and society as whole.
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“...representations (descriptions, determinations of many kinds) of ‘what the machine is’ take their sense from descriptions of ‘the machine’s context’; at the same time, an understanding of ‘the context’ derives from a sense of the machine in its context. The sense of context and machine mutually elaborate each other.”

(Woolgar, 1991)
Introduction

This thesis is an exploration for me, through which I have sorted my thoughts about perceiving the world and understanding in the moment of an activity. The principle inspiration has been literature, which recognises and handles artefact and artefact usage in a historical perspective. This has given me new perspectives on what actually is going on in practice.

Methodologically, the study was undertaken using an eclectic and flexible assembly of work shadowing, interviewing and questioning. None of this could have been done without the willingness of the subjects - nurses in a dialysis department - to participate. The intention was to capture the complex system of technology that a dialysis department is forming.

If technology is a way of using tools to extend our bodily ability (Wartofsky, 1979, p 197 ff), then technology is all artefacts. A knife is technology as well as a digital system that is running a process industry. In a historical perspective peoples’ lives are loaded with technology through artefacts and the knowledge of knowing how to use them. A person, born naked without any tools may not survive for a long time. Our survival highly depends on the fundamental tools and knowledge that make it possible to work the surrounding nature (Johansson, 1987, p 34). However, this statement also points to another property of technology, and underlining a difference between humans, animals and nature. This is that technology always has to go with knowledge about the technology – the purpose of its use, how it is consisted, how it is connected to other people, things and systems, and what benefits or losses it creates in the moment of the usage. Thus, a stone suddenly may be chosen for a certain purpose and is used without any transformation by a man’s hand. In the knowledge of the user, the properties of the things are considered being well adjusted for the purpose. Stones, then, may be used in flint technology when, for example, used as a hammer for knocking off splints, forming a piece of flint into an axe, arrowhead or perhaps a knife. Technology lies then in the knowledge of the usage rather than in the construction of the tool itself.

But technology, though being part of a complex system, can also be complex in itself consisting of a whole set of technological items connected in a way that gives each part a meaning in use in a larger system of other artefacts and people. Also, this knowledge of knowing which stone to choose, and further on how to hold it and how to strike the other flint, in my perspective not obtained by the stone itself, is learned, and therefore culturally inherited in both the historical and current society. A technologically complex system is then due to the knowledge and the experience of the people in the system; people interpreting, understanding and taking action upon the system and their aim to accomplish something (Constant II, 1987, p 228).

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1 These stones are very common at archaeological sites, but seem never to be presented in literature. However, they are easy to spot since they are naturally round and bear traces of hits on either one or two sides, and I have experienced how archaeologists discuss how these stones seem to have been so carefully chosen by their users.
In trying to introduce this picture I will lay out some expressions or terms that may help to grasp the reasoning in this thesis. People’s experiences and knowledge form the knowledge of how to use the technology. Knowledge about the system is inherited and also constantly developed through the change of technology and people. The knowing how may be translated into the term *Work Practice*, which in this thesis will describe what people actually do in their activities, not the intentions or dreams, but how they actually, in practice, accomplish things. This reasoning I find quite strongly connected to *affordance*\(^2\) (Preece, p 6) and therefore the artefacts themselves and what they bring to the people through form and material and so forth. The concept of affordance, though, is then only enforced when the artefact is implanted in the society. What I find lacking is the reason for even getting about to do an activity. I would like to call this *understanding* or even *questioning*, through which people both inherit and construct an understanding for the technological system in use. The inheritance is a complex matter that will not always present any logical explanations to people, but will instead emphasise a need for constructing, creating or taking over an explanation that gives the work practice its foundation. Therefore; the reflective reasoning in the activity is strongly connected to bodily actions and also the understanding of both the hardware and the software parts of the system\(^3\).

Complexity may in many cases be difficult to grasp – to understand as a whole. But I dare venture to say that both professionals and laymen never actually understand the technology *completely*. The understanding of the system is constructed to give a meaning to the specific activity and the artefacts may admit access to understanding on different levels.

There is a vast range of technological systems that we give an explanation to that is “enough” or “adequate enough” (could also be seen as “satisfying”) to somehow understand for using the system. Using a simple example; when I think about my car that I drive every day to the university I must confess that I do not actually know how it works. I know there is a motor, that it is running on petrol and that I can manoeuvre it with some kind of steering mechanism. I also know some typical words like camshaft, fan belt, and radiator, and I can imagine the purpose of these. Nevertheless, how they actually are connected to each other is a great mystery to me. That is, there are elements I do not really find it necessary to know. I am not going to build a car, just drive one. And somehow I can always give the mechanics some hints about what is wrong with the car when it is time for repair or service, even if I do not know what the real problem is. Despite the absence of knowledge I find myself a quite good judge of how well the car is for driving, if it has a good grip on the road, if it is smooth enough and if it is a good car when it is time for acceleration. In other words: I know just enough to be a user of the transportation. That is if the thing does not break down in some road somewhere out in the woods.

However, my knowledge of my car differs quite a lot from the brand mechanic’s. Compared to the mechanic’s, mine is very local, focusing on only *my* car. I know that it is hard to get started when the weather is damp and I know the noises it makes and reacts immediately when I hear a new one.

Explaining the world in a local perspective occurs everywhere and everyday. Sometimes we need to explain grand things like our existence; through the “big bang”, a

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\(^2\) Originally defined by J.J. Gibson.

\(^3\) These terms will be presented in chapter *Technological systems as meaning and function.*
creating god or a birth through a water-bird’s egg. Sometime it is something small; why
the printing of a document is not coming through or why the lead is stuck inside the
pencil. Instead of making things that are hard to explain mysterious, we give them a
reasonable explanation that will make it possible for us to use the item and move on and
live our lives.

When looking at other cultures this becomes quite clear to us. The explanations might
seem naive or backward and moving from one perspective to another will call upon
major changes, sometimes for a whole society. One example I find interesting as well as
amusing, and which I find illustrates my viewpoint in a clear way, is a notice that was
published in a South Swedish newspaper 120 years ago. This was a time when the old
folklore of the agrarian society in Sweden was giving way for the new understanding of
mechanics, technology, medicine etc. These were disciplines that sometimes ridiculed
the farmers’ view of the world, which was filled with all sorts of beings explaining the
structure, happenings and outcomes in, for them, an adequate manner. Many researchers
of that time realised that an era was coming to an end and made it their task to describe
and save this to the after-world. The researchers belonged to the new way of thinking,
well educated and many times finding their home region retarded and old fashioned.
But, one should not forget that this was the society that they were brought up in and that
formed them during their upbringing. Changing perspectives was not done without
effort and there are examples of how the two different views of the world were kept
parallel to each other.

This notice was published in Smålandsposten⁴ in 1884 by one of Sweden’s most
prominent ethnologists and scientists - Gunnar-Olof Hyltén-Cavallius (1818-1889):

Further entirely reliable messages about the Dragon or the
‘Lindorm’ is received with gratitude.
He who, at Sunnanvik farm, delivers a killed example of mentioned
Snake receives a reward of from One Hundred to One Thousand
crowns, according to the size of the example or other qualities, as
soon as this, in tight barrel with poured spirit or aquavit or even
just killed, is delivered to the undersigned. (Smålandsposten 1884)⁶

If Hyltén-Cavallius ever received a Lindorm is quite unclear, but there were a
tremendous amount of messages and testimonies with very detailed descriptions about
the snakes appearances published in local news papers all over the country even as late
as 1900’s. Even for the prominent ethnologist it was hard to completely change his view
of the world, even though he was considered being a scientist of the New World. His
way of adding a request for examples of the dragons to his announcement seems like an
action taken “just in case”, that is that he feels he might still be wrong concerning the
notion of the new scientific world. This notion is inherited through the culture and the
society he was brought up in.

This picturesque story exemplifies how major paradigm changes are, with great
problems, transforming the society, this because the understanding is strongly
connected to the historicity of the society. A mental, logical understanding is not
enough to convince a person with a local history of the reliability of the new paradigm.

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⁴ A local news paper that still is in use.
⁵ Lindormen (Lindwurm in German) was the name of a huge dragon-like snake, sometimes black
sometimes white, with mane and a sting at his tail. A very common figure in European folklore.
⁶ For Swedish version see Appendix A.
What I find in Hyltén-Cavallius’ text is a way of blending scientific and local knowledge, which is a part of every day life. On one hand he has to deal with ”facts” that his research community is presenting to him and on the other hand he is strongly influenced by his local community, where witnesses and stories told by people close to him.

In my attempts to find out how understanding and inherited understanding relates to technology, history and society, I want to point out that I am not focusing on the forces that emerge new innovations in a society, for example strong and overwhelming aspects as power, politics, economics, propaganda or perhaps trends. Those issues are interesting enough, and treated frequently in research literature (Constant II, 1987. Smith & Alexander, 1999. Bijker, 1987, etc). I concentrate my efforts on a, in some ways, smaller scale of technological understanding. My interest is, firstly, in how use of technology and technological systems is depending on the understanding of the system and the intent of using the system. Secondly, I wish to point out the complexity of context that every system is due to. There is no isolated system and it is highly dependent on the understanding of the people involved in the system are brought onto the scene of founded knowledge through experience, which causes new interpretation and action of the situation.

Many of these issues are not visible until time has passed; when traces of events, changes of artefacts, memories and narratives are washed out and leave something that we would sometimes like to call historical ”truth” (Sievens, 1990, p 221). But, I find it necessary to underline that there is no point in trying to bring out this ”truth”, since society only exists when people live their lives and use language to describe it (Moerman, 1996).

The necessity of getting close to what people actually do in a specific setting could then not be underestimated, and the need for understanding this in design of technology, and in my specific genre information technology, is spelled out by many researchers in this discipline (Blomberg, Ehn, and more).

My contribution to this discussion is an indirect critique of former research where historicity and tradition have been left out. I want to underline that, in my point of view, work practice is not about doing things in the most cost effective manner, concerning economy, time, power and so on. Work practice is connected to understanding, and since understanding is due to history, also a learned practice and a bodily understanding for the work being done.

In studying contemporary social settings I see a problem. In slicing the reality into segregated pieces of happenings, history is no longer visible and its value subordinated. The question why something is going on in front of one’s eyes is consciously avoided and of course, because of that, never answered. It is necessary to underline that why does not mean that we are searching for a historical, chronological happening, tracing down a source of some kind. That does not explain the understanding. Why, in my sense, is more a way of taking focus off an assumed efficiency.

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**Background**

My own background as an archaeologist has clearly formed my view of examining the world. Archaeological research has a developed ability of trying to understand material and traces left by people in another time and another culture. As the anthropologist Tim
Ingold (1999, p ix) mentions archaeologists have a severe problem; they are always too late. When they arrive the people have long been gone and the only thing they have left is the things they used. Out of this archaeologists have always tried to bring out some understanding of the activities that have been going on. A problem is that even researches that study contemporary cultures may treat the material in this way. However, the technique of dealing with artefacts has proved to give interesting facts, although today, typology, morphology and function have to stand back for more ethnological methods moving the focus from tangible sides to give "life history" to the artefacts (Dobres, 1999, p 128). In order to reach some kind of picture of a contemporary culture it is necessary to take focus off the artefacts in favour of practice and meaning in usage of artefacts. But these activities, I believe, are formed, valued and emphasised through the culture and the final "meaning" will not be caught until the practitioners have described their thoughts of how they perceive and understand the activities they are participating in.

When I four years ago decided to learn about technology, and specifically computer technology, I believed that I was leaving a perspective of the humanities in favour of a more technology-driven one, bringing in engineering as a new way of looking upon the world. Even so, during these years it has become even clearer to me that my view of the relevance of people’s lives has been strengthened. My greatest critique of the methods that were used on archaeological material in the 1980’s was that they were all too much driven by a perspective of natural science, where people assumed the criteria of being general, efficient and rational. Still, these questions are the ones that today interest me the most. Why is it that people are driven by reasons that "seem" irrational to the viewer, not traceable in rationality, cost and time efficiency and that are, in many ways, exceptionally local and unique? A rather striking example I find is one of the most revolutionary changes in technology that ever happened to people – domestication of animals and cultivation of herbs (Sundin, 1995, pp 8). For a long period of time scientists believed that this change was due to a need in making the producing of food more efficient. Nowadays, archaeologists agree that this new way of treating food was demanding more time from people. While hunting and gathering were activities that were done in periods, leaving quite some leisure time to people, cultivation is time consuming and demands great preparation of methods, material and tools. Also, in the beginning, the crops could hardly have been great. There had to be a gain in knowledge, development of tools and also a refinement of grain to reach a level of satisfaction, that would inspire a continuation of the activities. So, why even bother to learn the new technologies? Rationality and efficiency are not the only forces of changes in society. There are many others that come to one’s mind when just lightly philosophising about changes; like politics, power, fashion, aesthetics, and interest in novelties. Also, changes are related to things in society that keep it somehow steady and not as sensitive to changes as could be theoretically possible. Here the need to understand structure, heritage, tradition, and identity as examples of factors that form society and that are, perhaps not, very much connected to rationality or efficiency, becomes evident. The will to learn the new technologies of cultivation perhaps has been formed by utterly different needs, for example, the wish of bringing some kind of “luxury” into the society, or keeping political power through owning new advanced knowledge, as maybe was the reason with the early hunting farmers that lived in the very south of Sweden more than 5000 years ago, who seem to have made beer out of their first crops (Jennbert, 1984).
In making this thesis I have come across a web of questions that sometimes seem impossible to sort out and at some parts I admit that I have given up and left it to later assignments. But, what I am actually trying to conclude is to put some light on a couple of concepts or aspects that I find have to be considered in any analysis of work and system, and therefore also design of artefacts and systems. One is time. In this term I include history, tradition, evolution, development, heritage and so on. When I mention time, it is not a measurable unit of time reflected upon and evaluated every day, but rather what is going on within this artificially constructed unit. What we can see is change – something that goes from one form to another in new views of the world, new beliefs, new knowledge, new tools, new what ever.

The trouble is to recollect and present time. On one hand I could slice out a single moment (or two, or five, or a thousand…) and then present a state, as done successfully in methods like activity theory (Cole & Engeström, 1993). On the other hand, I could also, as an archaeologist, give my main focus to time and make a slice out of space, choosing a certain place. Then I could present the development of time through this spot, knowing that if I decided to move this slice some 50 metres southward I would have to reconsider my time-matrix. Somehow, both methods appeal to me, but will not give me enough room to discuss what I have experienced in the dialysis department when observing and talking to nurses.

After a long time of consideration I have decided not to use any already defined models in analysing my material. They are all limited when dealing with changes over time, variations in the same community, and most of all, when considering a technological system. My view takes its viewpoint out of the perspective of the nurses, what they have to deal with in everyday work and how changes in their experience and understanding of technology all work together to form a dynamic in care and treatment. In this thesis you will find at least four parts that have been important to me to sort out and try to understand, as much as is possible for me as a spectator in this complex system of dialysis treatment. My objectives in this research is not to clarify a part of the world, but rather to find new angles for designing tools for complex technological systems.

First of all, I needed to confirm and settle the way I believe that understanding and knowledge takes place and happens in life. This includes a view of the world and how a person understands it in relation to own experience and the inherited knowledge of the world that has been built up during generations of direct handcrafted experiences and trials. The term \textit{perception} is therefore necessary to give, in my view, a proper meaning. The terms history and culture must also be considered, since I cannot avoid using them when discussing and writing.

Secondly, I needed to find out how to handle and describe how everything is connected in our world, not just as a cosmos, but rather as our ways of using artefacts and knowledge in our daily work practice. There are no autonomous systems and how do I then deal with that in my writing. My way of understanding technology in connection to knowledge and work practice sets frames for a discussion about technology, which does not limit technology to mechanics, but rather includes knowledge about using technology and also intents in using technology.

Thirdly, this discussion is taking place in the setting of dialysis treatment, at two departments at the county hospital of Blekinge. Therefore I need to present, not only a dialysis treatment as a general health care activity, but also dialysis treatment as specific work practice in a setting of complex technology.

Finally, I try to bring these three parts together in a discussion about time and complex technological systems in a dialysis treatment setting. My thoughts are then
enlightened through examples of practice in specific situations in the dialysis care, which I have either experienced or which has been told to me by the nurses.

Methods

Throughout my study of dialysis care I have used ethnographical methods. By moving around in the dialysis departments logging (Ely, 1993) happenings and dialogs I have tried to get a grasp of what actually is going on in the department. In the logging activity I have found interesting issues that I have been able to follow up with discussions and interviews.

Considering the limited time for the project I must define my ethnographical work as Quick and Dirty Ethnography (Hughes et al., 1994), being done without any possibilities to actually reach a perspective of the dialysis treatment as work practice “from within” (Garfinkel, 1984). From the first step in my ethnographical studies I was very much aware of this circumstance. However, prior to this ethnographical study, I have spent several hours at the very same department, while I participated in a design project more than a year prior to the finishing of this thesis.

I have not worked with a hypothesis to prove. This is a study about people and their understanding of their environment. My assumptions about the area of dialysis was not nonexistent, but although limited. It would have been presumptuous of me to believe that my knowledge was deep enough to form adequate question of Work Practice when I started out my work. Also, doing a study with ethnographical methods, it is built into the method that my view as a researcher is a curious (at the border of stupid curiosity) one (Ely, 1993).

It lies within the paradigm to look at the scenery with open eyes, avoiding prejudice and prior assumptions. This is also a stand point when going into a design assignment.

I have also conducted a set of more or less regular interviews (or rather dialogues) with a handful of nurses. The head nurse at the county hospital appointed a nurse to me, whom I will call Margareta. Margareta introduced me to the new department and with her I started my first fumbling trials to find a focus of my interest. I have also had other informants that unfortunately had had less time for any proper discussions. By moving around, doing my observations in the department, I have also had several spontaneous talks with at least four other nurses sharing their thoughts with me.

I have also been in contact with three nurses at the second hospital in the same county and also a nurse belonging to a different region. The latter nurse turned out to be an important source in my studies.

Observation and asking questions, then, constituted a primary method. To a lesser extent I have also used one or two video cameras. First of all I wanted to capture the activity in the corridor during the first day of the new department in use. However, moving around the dialysis department, where patients are in bad shape and sometimes feel very unwell, I found myself very uncomfortable with the camera in my hand. Firstly, it was hard for me to both concentrate on the camera and the object (or person) in front of it. Secondly, I found the persons I filmed more concerned about expression and what and how they said or explained things. I found this a bad influence on my study. I had to make a decision, choosing between being present at that exact moment or concentrate on the material at a later occasion. I have never at any former projects experienced a frustration in video filming. Perhaps the fact that I was doing the
ethnography on my own made a difference, in holding the camera and conducting a
dialog at the same time.

Instead I have tried to observe the nurses in different situations and as soon as
possible follow up with questions about what actually happened and how they decided
upon their actions or how they thought about a specific situation.

Handling data
The data consists of logs from the dialysis department and interview material with
reflections about practice, explanations about the dialysis process, and narratives about
unique situations. Interpreting the material is strongly influenced by my ability to grasp
and understand the complex system of dialysis. The material is just a sample of
elements pointing at issues I find interesting and important for determining practice and
understanding.

The data is collected in video films, but mostly in hand written diaries and shorter
notes. Sometimes the material has been used to raise new questions to bring back to the
nurses and at other times a striking quotation has led to a deeper discussion and further
understanding for the work of a dialysis nurse.

Literature sources
In all the reports and theses I have written for PCW (People, Computers and Work) at
the Blekinge Institute of Technology, I have always included literature that has been a
part of the educational program. The specific discipline, People, Computers and Work,
might in some ways be defined by literature from fields as ethnomethodology,
computers and learning, work practice, HCI, CSCW, Participatory design, and so forth.
The literature from these disciplines has, during the eight years that the study program
has been going on, formed perspectives and standpoints that are somehow equal or
similar to the members of the PCW-community.

When starting to work on this thesis I believed I would continue to use this
collection of literature that I had gathered over three years. But it turned out that I,
during this project, had found my way into another manner of asking questions about
society and technology. This I could not completely find in this literature. Instead, my
former experience within archaeological and anthropological research raised new issues
and aspects, dealing with time and change, enlightened to me in a new way. This is why
several of my references are to be found within these two disciplines. Also, texts about
dialysis research together with literature that treat technology in a social and cultural
perspective have been inspiring.

The lack of PCW-literature I believe is due to several things, but one is that I have
not in any way had the ambition to do any design. IT-design is a major part of the
education and I decided early that this was not what I wanted to do. I believed that an
attempt to do design would do the exact mistake that I want to point out in this thesis;
that complexity is not treated well enough in design/ethnographical situations. My
ambitions to do an analysing and describing work made it necessary for me to find my
sources somewhere else, in disciplines that have great experience in handling time as a
core issue.

People, Computers and Work is in Swedish called MDA (Människor, Datateknik, Arbetsliv) and is a 3-4
years study program which emphasizes Human Work Science and Computer Science.
II. A view of the world

I have chosen the expression *view of the world*\(^8\) to describe what I believe is what every individual belonging to a society or culture perceives when looking upon the world. The view of the world is the perspective that the person obtains through living and acting in the world, by which it is formed through experiences of upbringing, education, practice and, on the whole, interacting with other people. Sociologists, ethnomethodologists and ethnographers originally use the expression *view of the world*. By anthropologists this is defined as being "historically specific cultural systems of representation" and it is underlined that the world view-approach need to take into account the every day social experiences and political strategies of technical agents in order to form a full understanding (Dobres & Hoffman, 1999, p 2).

By using this expression I want to state that it is not a mentally formed model that, with more or less success, has to be fitted to the world outside, but rather a perspective that colours the understanding of the world.

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**Perceiving the world**

Every person that lives in a world has a view of the world that he or she is relating to. It is a way of understanding the world, how the world is constituted according to different materials – if it is tenable or perhaps fragile, how it is shaped and what the outcome of a specific action might be. For example, we tend to apprehend our relation to our western society as well balanced. We have a clear opinion about our ability to keep an objective perspective – we believe as a community that we live in an equal society, we do not believe ourselves to be religious fanatics and we believe we have a clear and scientific view of the world and how it is constituted. But we also know that there are different ways of looking at aspects of life. There are values, beliefs, tastes and conceptions, which give variety to the world. These organise a culture of understanding and seem to be robust, but are still changeable. There is behaviour that is tolerated, both from other people and artefacts in our world, and therefore considered as being “normal” (Douglas & Wildavsky, 1982). In this way accidents, for example, may be seen as “normal”, because they are inevitable. This is due to how they system is tied together.

Adjustments in one part of the system (to avoid some kind of failure) may generate three new interactions (Perrow, 1984, p 4).

Culturally formed characteristics may then be seen as part of the natural world, something fixed and not within reach of influence. No one would probably contradict peoples’ influence on nature; polution, cutting down trees and settling. However, what is “pure” nature? Can people’s relation to nature actually exist unconnected to society and culture? I believe that nature, and the perception of nature, is loaded with cultural values and ideas, where people bring some kind of order or organisational perspective into the meeting between man and nature. And considering that last sentence “…the meeting between man and nature…”; how could even humans be parted from nature? Humans are biological beings in the world. The ever so discussed tension between nature and culture is also a sign of people’s needs to socially and culturally organise what we perceive as being the world we are all living in.

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\(^8\) Originates from Max Weber’s term *Weltenschaung*. 

**Perception**

The view of the world, in my point of view, is founded in the belief that we perceive our world through activities. There is no passive registration of input to our senses. The world has to be experienced through acting. The understanding is then built upon experience. People relate themselves to the surroundings through artefacts, space and other people; people function in a social conduct and it is this whole that people can perceive. Marx W. Wartofsky (1979) describes the human perception as a variable, which is related to historical changes in different forms of human acting. Perception is not an activity that is capsulated in a sensory organ:

“...eyes don’t see; only whole organisms with visual activity see with their eyes; and even these do not ‘see’ when the visual activity does not involve the action or life activity of the organism” (Wartofsky, 1979, p 197 ff)

The perceptive action takes place in an organism’s life-space and life-time and is mediated through a so called internal representation, which points out that perception is neither a simple reflex nor a reaction to stimuli from the outside (Wartofsky, 1979, p 197).

The historical development of perception is not possible to report in neurophysiological structures. The human perception does therefore only start to develop in a historical human acting. What separates peoples’ acting from animals’, Wartofsky points out, lays in the fundamental activity to produce and reproduce necessities for existence and survival. This is not unique for humans, since also animals reproduce for the survival of the species. But what humans do, on the other hand, is to produce artefacts, which function as extensions of the “animal” organs (Wartofsky, 1979, p 199).

**Culture**

The view of the world forms a vision of my world, or should I say that it forms my vision of the world. But this view is not entirely mine. I share perspectives with others, creating a common culture or common sense. This is defined and declared through the interaction of people, done through a language, confirming that what we perceive is actually a part of our shared world (Moerman, 1996). The conversation analyst Michael Moerman discusses the aspect of “the real world”. A general experience from ethnographers, he points out, is that people they study seem to live in a different world than themselves, since they have other “assumptions, perceptions, judgements and experiences” of the world. The difference between the ethnographers’ perspective and the informants’ sometimes may also seem exaggerated. But, Moerman claims, it is possible they actually live in other worlds. He refers to Heidegger (1967, p 37, 63, 64) and states that it is how we assert, address and propose when referring to a world of “things”:

“For ethnographers and conversation analysts ‘the world out there’ is a verb; a social activity, not a pre-formed thing” (Moerman, 1996, p 102)
Reality is then constructed through the activity to talk about it (Moerman, 1996). In this sense people speaking the same language have the same view of the world. Perhaps this is valid in some ways, but it is not by far covering all aspects. Researchers challenge this and avoid the term language by exchanging it for terms like discourse nits or fashion of speaking. Moerman suggests that there is a need for researchers to attend to talk as being made public and socially compelling in order to figure out how a view of the world is shared, recognised, maintained or socialised within a community. Through talk we prove that the outside world exists. We agree upon the world’s properties by talking about it in the same way. This kind of talk is socially organised in the situation when it actually is occurring, and is ruled by action taken by the participants. When talking we have to act on rules for talking, behaviour and conduct and can never thereby work as not being connected to other people (Moerman, 1996, pp 102).

My definition of culture (and view of the world) is founded in Moerman’s view of how the common sense is “acted out” through language. This is the one I have chosen, and which I find suitable for my understanding in this discussion. I am aware of other definitions and those may not contradict this one, but I will not bring them into the discussion, since I find Moerman’s the most interesting and adequate one.

I would also like to add another surface to this; “the acting out” does also become visible through artefacts and also through work practice, which naturally are closely connected to speech.

Culture, in my view and in the perspective of this thesis is clearly a verb, as Moerman indicates, through the activity of speech and work practice and actually also through the making and using of artefacts, this because perception is an ongoing activity which is carried out in every day life.

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**History**

The problem with looking at history or tradition is that it is not shaped until looking at it. The sociologist Bazon Brock (1986) has formed his thoughts about tradition by studying new art. He claims that no art is actually understood as avantgardistic until it actually reshapes society. And to make this obvious comprehension about relationships between historical events can only be perceived when looking back in time backwards. Historical events are then united as ‘history’ through the forming of a new tradition (Sievens, 1990, p 221). In this viewpoint, time for change is therefore obvious in forming new understanding and new perspectives.

To understand time as a graspable concept one prefers to measure it with a standardised method – hours, minutes, seconds, and so forth. Another, in my view, more meaningful way is to look at change and traces of change in the surrounding environment.

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**Understanding the world**

Understanding the world is a balance between a theoretical knowledge and an experienced one. Knowing the world theoretically is something we learn through formal or informal education. Generations of knowledge that is built into the society through the production and presentation of scientists that have made it their task to explain the world. By spreading and reforming their conquests’ knowledge is somehow inherited by the culture, passing on a view of the world that becomes general to the same culture. An experienced knowledge is also founded in the culture, and though it might sound as if
these two aspects are separated the experienced knowledge is well connected to the theoretical knowledge. I would like to present this relationship as dependence. Theoretical knowledge comes out of some experienced phenomenon of the world, in an urge to try to explain what actually is going on. Also, this explanation is founded in the understanding, by creating explanations and representations in the form of less or more simple models. My “real life” experience of this knowledge is most of the time quite scarce. Well, I know that Newton’s first law works. His apples as well as mine tend to fall downwards, without making any detours on the way. This is an experience that I cannot doubt. Understanding the mechanisms behind the fact, though, is something I have to understand through other peoples’ efforts and trials, and established representations. These are all fantastic in my view, since they have to go beyond their own graspable world to form their theories.

The view of the world is a perspective that is founded in the experiences of living in that world, both as a theorist and a practitioner. And by living and acting in my life my view of the world is never a static picture, but rather a whole that is dependant of the context and the moment in which everything occurs (Wartofsky, 1979. Moerman, 1996).
III. A Study of Dialysis

Description of the study

A part of a larger project
The reason for choosing a dialysis department for the field study was a continuous interest for that kind of environment. During the term before the writing of this thesis I was involved in a design project conducted by the county hospital, the county council, the university and a medical company. This was the result of a co-operation that started in 1997. The sub-project’s intent was to design a technological solution for the dialysis department and made way for a cluster of studies that has been going on during the current spring.

Since I had spent quite some time at the dialysis department I found myself having built a good background knowledge that could be useful for a study. During the whole project time the department was preparing for a move to new facilities and these discussions among the nurses in time caught my interest.

I have also done some complementary visits and dialogues at another dialysis department in the region and also an interview with a nurse from another region.

Informants
I have visited two dialysis departments, but one of them is my main target. The two departments belong to the same region and county hospital, but are situated in two different hospitals in different cities. There is some co-operation between the departments concerning education and use of doctors. They are approximately the same size and have the same amount of nurses and patients. The secondary department might just be a little bit smaller.

As a sub-project to a larger research project finding informants for the field study was quite informal. Through earlier work contacts with head nurses, doctors and other medical staff at the County hospital of Blekinge, was already established and discussions with the head nurse of the department lead to a co-operation. She appointed a nurse for me that I could use as a main informant, and also another one that could work as a backup depending on which one of them that was working at the time. But during my visits at the dialysis departments, dialogues and reasoning occurred with any of the nurses present in the department and my data is fetched from any of these discussions.

Two of my informants are both women in their mid thirties - Margareta and Christel. They studied to become nurses in 1980’s and started at the department as dialysis nurses 1989 and 1987. They have experienced at least three major changes concerning dialysis machines and also routines at the dialysis department. Some of the other nurses have experiences of dialysis care that goes back all the way to the 1970’s and others have started their career as dialysis nurses during the 1990’s.
I have also visited the dialysis department at the second hospital in Blekinge. These two hospitals share in some senses resources, for example, technicians and doctors might sometimes be working in both departments. Here I have had contact with three nurses - Lina, Katarina and Petra. Especially Katarina and Petra gave a lot of information that put many questions in new or clearer perspectives.

As a complement I have also had long discussions with a dialysis nurse from another region. She has worked as a dialysis nurse for a little bit more than five years and has already experienced two different hospitals belonging to two different regions. Since I had a personal contact with her (I call her Anna-Karin in this thesis) before this project I have been able to sit for very long sessions with her going over issues several times. In contrast to the other nurses, I have not had the opportunity to visit her department.

I have chosen to give my informant nurses fictional names. The reason for this is some of the episodes narrated to me are of delicate cases that I partly have chosen to represent in this thesis. Despite this it is important to mention that in these cases the actions taken by the nurses would not have lead to any other results. The outcome of the incident was not due to any failure from the nurse or the machine.

There are also witnesses from other nurses than those I have mentioned above, these persons are not mentioned by name.

In the text I have tried to include also doctors and technicians in the discussions. However, my focus has been on the nurses’ work and I therefore narrate largely from their perspective. I am aware of that in many cases in the text, the same work, interpretations, decisions and so forth, also account for doctors. But in order not to complicate the text I have sometimes deliberately excluded them from the discussion.

What the nurses say in combination with observations of what they do is what is making the picture for me. And the nurses tend to say different things. They have the same conceptions but they show different angles and explanations into the subject. And sometimes they probably mean exactly the same thing, but they describe it in a different manner. More than one of the nurses has brought to my attention that for every question I ask I will most likely get a new answer.

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**Renal diseases and treatment**

The facts that are presented here about dialysis treatment comes either from literature that the nurses use themselves for their work, or from statements by the nurses through the discussions I have had during my ethnographic study.

The blood is functioning as a thoroughfare for transportation of various kinds of substances that need to be passed out; firstly to different parts of the body, secondly for
signal substances between different tissues, and thirdly for the cells and factors that produces the immune defence of the body (Gambro…).

The blood passes through the kidneys, which are two vital organs situated in the back of the abdomen on either side of the vertebral column. The functions of the kidneys are twofold. The kidneys have to adjust the water level in the body and remove waste products as well as produce important hormones for the body (Gambro…). The product of secretion is urine, which in most parts consists of water, but also urea, cretin, salts and acids. The kidney is provided with blood through a kidney artery, which is a branch from aorta. The blood then leaves the kidneys through the kidney veins out into the vena cava and returns then to the heart.

The reasons for contracting a renal illness can be very varied. Inflammatories, severe urinary infections or prolonged diabetes are examples of some frequent causes. Also reduced flow of blood, congenital kidney disorders or trauma to the lumbar region may cause chronical renal failure, which means that the damage is irrevocable. A partly reduced renal function could though be adjusted with a restricted diet. There is a need for treatment through blood dialysis when the kidney function is as low as 5% (Gambro..).

![The kidneys](image)

**Fig. 2** The kidneys (Gambro…)

Today there are three treatment alternatives for renal failure - kidney transplantation, haemodialysis (i.e. blood dialysis) or peritoneal dialysis (dialysis with help of the stomach).

Before 1960 there was overall not any kind of treatment for the diseases, but the patients would in the end die of uraemia, that is a gathering of water and waste-products in the body, which will gradually destroy the systems of the body. This process was in most cases rapid and acute, the patient would be intoxicated in only some weeks.

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**The history of dialysis treatment**

The history of dialysis is a development of both understanding new technology as well as human physiology. To arrive where dialysis treatment is today was not done through a single path of technological innovations, but rather on several levels and in different directions over almost a hundred years. Technological understanding has lead to testing, long-term treatment and then to new understanding of how the body answers to the treatment. This is today still an ongoing process.

In the late 19th century and early 20th century the papers written on for example anticoagulants were of an empirical nature. They did not actually explain *how* it was
possible for leech saliva to stop the blood from clotting (Fagette, 1999). This is one example of how new understanding has emerged and in the end would lead to a research in treatment of renal failure. But caring for dialysis patients did not only start during the 1960’s with haemodialysis for patients with chronic renal failure, but was actually founded in the nursing of renal patients from the 1920’s. The difference from today’s treatment is that during these 40 years nursing was focusing on reducing symptoms within the general medical environment and not on treating the patients specifically for their complaint (Bevan, 1998, p 730).

Technology at the dialysis department

Technology at the dialysis department is a vast and complex system, where every element depends on every other element to make dialysis treatment possible.

There are at least three systems that can be considered forming three units. The first, and perhaps most obvious one, is the technical equipment that is used in the actual dialysis process. It consists of dialysis machines, one for each patient. This whole set is described by the nurses as an external mechanical kidney. At every treatment, other devices as tubes, filters and containers for saltine, bicarbonate, infusion solution etc will be attached to the machine.

The second part is the alarm system, which includes dialysis machines, patients and other technical equipment.

Finally, dialysis treatment is not possible to conduct without the usage of tremendous amounts of clean water, which will, amongst other things, serve as a factor in the process of diffusion.

Dialysis machines and equipment

The dialysis machines are serviced and fixed by the technicians at the department that are specialised on dialysis machines. As soon as a machine is not working the way it ought to, the technicians either try to fix it directly in the patient ward or if the problem is not solved quickly enough, bring it into the technicians’ room.

The dialysis machine in itself is not actually the ”artificial” kidney. It is the filter or the membrane that is doing the cleansing of the blood. The function of the dialysis machine is to pump the blood from patient to machine and back to the patient again, and to keep track of different values. These values can for example be derived from ultrafiltration, pressure and air detection. The machine can also run the process in a certain way according to the profile set by a nurse for specific patient (Gambro…).

During a dialysis beat the patient is connected to the machine for approximately five hours. The machine is set to exert a certain amount of fluid from the patient and also control if the values keep within selected parameters.

Other equipment is necessary for pricking the patient with needles, both for being connected to the dialysis machine and for different types of blood tests. There are two rooms in the department especially for medical equipment - the storage for all kinds of nursing equipment and the medicine storage for all the medicines that are used in the treatment and also for other treatments.
Alarm system

Every dialysis machine has an automatic alarm, with a pulsing sound and a flashing light on the top of the machine. If the responsible nurses were to stay in the wards during a whole ‘beat’ this would probably be adequate. Staying in the wards is due to how the organisation has evolved through practice, political and economical decisions, organisation of work and division of labour, and also the way the department is built and how the resources are distributed throughout the department. There are departments where there is room for the nurses in some of the wards and where they have enough equipment and space to do administrative work in the ward instead of in the nurses’ office.

At the departments I have studied, the nurses are constantly moving in and out of the wards. Therefore an external alarm system has extended the local alarms so they will be noticeable throughout the whole department.

The alarms can roughly be divided into two parts – alarms triggered by the patient and alarms triggered by the machine. It is important for the nurses to know what kind of alarm that is activated. The machine alarms usually concern the physical dialysis treatment indicating that there is a problem with the process. The patient might be suffering of low blood pressure or for example lack of salt.

A patient alarm could actually indicate a broader spectrum since it is the patient that is deciding upon pushing the alarm button. But some of the more common reasons are that the patient is in need of some kind of service, something to drink, an extra pillow, discussion of a problem and so on. The dialysis machine has a tendency to be very sensitive, a small movement of the arm and a different level of pressure caused by a change in needle position might activate an alarm. This, and the fact that some of the patients are in a very bad shape, give the patients very little room to take care of service by themselves.

There are also other alarms that occur more seldom. One is the emergency alarm that a nurse can activate to draw attention to her from the rest of the staff. This is used when needing extra help if there is some kind of incident. But it seems as if this is handled by just telling the closest colleague to step in, and the incident might not then even be categorised as an acute situation since it was so quickly under control. Also, the water cleansing system might at some occasions cause alarms.

These alarms are all presented both through sound (a soft digital beep tone) and through a coded number onto a display system distributed throughout the department.

Water cleansing system

The third technical system at the dialysis department is the water cleansing system. It is of outermost importance that the water is cleaned properly before it is used in the dialysis process. There are two obvious reasons for this. One is that the basic technique for dialysis is to use diffusion. To make the toxic move from the blood to the dialysis fluid the concentration of particles must be higher in the blood than in the fluid. On the other hand particles from the dialysis fluid (if not accepted ones) must not diffuse into the blood creating more damage. An actual case that is still discussed among the nurses is an accident that happened in the middle of 1980’s in another hospital. The local water contained high concentrations of aluminium, which was stored in the patients’ organs, mainly the brain, causing prevailing symptoms of senile dementia among the patients. While a person without any renal diseases consume at the most one or two litres of
water per day through drinking, a dialysis patient is exposed to tremendous large amounts of water through an average of five hours a treatment, three times per week. Adding to this was the usage of certain medical preparations to bring out phosphate from the organs to the blood to prepare for dialysis. These preparations contained in those days high levels of aluminium, which added to the damaging effects of the water.

The dialysis process needs a very large amount of water during a treatment beat. Add to this at least a total amount of 24 patients. The water supply is therefore in need of a pumping and cleansing system that is separated from the hospital’s regular water system. Today the system is environmentally adjusted; that is that there are no chemical used in the system and it will not leave any waste products. At the old department, the nurses had to handle peracetic acid in big containers. There were a couple of major incidents where nurses either inhaled the acid gas or were exposed to the acid onto their skin. Because of these accidents they installed a new water system in the new department.

There are two kinds of alarms that are generated by the water cleansing system. One is failure of pumps, vents or filters and this will be presented onto the displays just like any other alarm. Another one is connected to the regular cleansing of the so called "water line", i.e. the pipes taking the water from the water room to the wards. Every morning at approximately four o’clock the apparatus will let hot water flow through the system in order to kill all germs. A caution lamp located in the corridor and the wards and rooms will then be turned on showing a flashing orange light to warn that all water connections are dangerously hot. This hot cleansing is supposed to be finished before the first nurses arrive in the morning at seven o’clock.

### Work Practice in dialysis care

In a dialysis department there is constant motion. Nurses move from ward to ward, from ward to storage, from storage to office, somehow guided by the frequency of alarms activated by dialysis machines and patients. These areas are all connected by the corridor, which is not merely for transportation; leading nurses from one end of the department to the other, but is also a centre for information. Even though the new department have some kind of displays in all the rooms they are not presented at all times. In the corridor, on the other hand, all alarms and presence indications are shown at all times. This is true in the old alarm system (the one they used in the department they used before the move) as well as in the new department. There is also a large digital clock in the corridor beside one of the displays. Some nurses do have individual watches, but the one in the corridor is the one that all nurses refer to when, for example, letting in the patients in the morning or noting finishing time for the dialysis treatment. This is the time that is put down in protocols and journals.

Apart from displays, nurses will find other nurses in the corridor, by which they know the whereabouts of the staff in the department. They know whom to turn to and where to find them. Nurse Margareta explained this phenomenon like this:

0:11:40
M: And you always know. It is always someone that informs you [that they are leaving]. Perhaps not when going to the toilet, perhaps you don’t say that...cause we know anyway.
(laughter)
A: Can you know that?
M: O yes, we hear that.
(laughter)

What the nurse is talking about is that they use also other senses to scan the department for colleagues and that this is done both deliberately and unintentionally, by telling each other and using vision and hearing in keeping track of each other. The department is an intimate place, somehow like a family, where all the members have an approximately location of the rest of the lot.

Knowing where colleagues are is essential to the work and divisions of responsibilities in the work. In the studied department there are always at least four nurses that have extra responsibilities during a treatment beat. One nurse is then responsible for two patients. There are also nurses doing other work in the department - doing administrative work, organising schedules, taking care of materiel and so on - and these nurses may well step in when the responsible nurse of some reason is not able to take care of an alarm.

This co-ordination is sometimes done smoothly without any noticeable communication, sometimes with an exchange of looks or a gesture and at other occasions there is an explicit "I'll take that", which will clear all questions about division of labour. (Svensson & Tap, 1997)
IV. Technological systems

To me there is no point in separating computerised technology from other technology. Perhaps a study with such a focus will bring out several interesting issues, but in this thesis I cannot see the reason. Computerised technology is a very essential part of dialysis technological development, since computerisation has led to more precise measurement and therefore also more precise results of treatment. It has made differences for both nurses and patients. Computerised technology is a great part of dialysis treatment as well as pumps, x-rays, hormone medicine and so on. My main focus – inheriting understanding – does not actually become really interesting until the focus is moved from computers as a part of technology to towards treating it as a whole.

However, I do strongly believe that experiences drawn from this study are utterly important for the design, construction and building of digital technology. Describing and understanding society, culture and understanding is important in any development of artefacts or systems.

Artefacts and technology - background

The term technology is a combination of the Greek techne (art, craft) with logos (word, speech). In Greece it represented a discourse on the arts, both fine and applied. It appeared in English for the first time in the 17th century, and was then used to mean a discussion of the applied arts only. By the early 20th century, the term represented processes and ideas in addition to tools and machines. In the 1950’s technology was defined as ”the means or activity by which man seeks to change or manipulate his environment.” At this point there is a discussion about the difficulty to distinguish between scientific inquiry and technological activity.

Technology could be seen as the systematic study of techniques for making and doing things, while science is the systematic attempt to understand and interpret the world. Science began at the same moment civilisation started using skills as literacy and numeracy. Technology, on the other hand, is as old as manlike life (Encyclopaedia Britannica).

So, I would like to underline this statement, the literal meaning of the term. Logos (talking) about techne (craft) is the possibility to understand, develop, create, build and use technology through ideas represented through the very same technology. The technology is then in itself explaining and representing the culture – how it should be interpreted and how it should be understood. Perhaps does this definition bring in the definition of science – there is no technology unless there is an ambition to understand and interpret the world. This does, though, clarify my view of the world of technology.

Technology and artefacts in a social perspective

In the 1950’s the archaeologist V.G. Childe defined technology as the physical concrete expression of human thoughts and ideas. This aspect makes study of technology a good entrance into the culture of a society, but is perhaps somehow limited. The challenge though is to bring forward the connection between culture and technology (Dobres & Hoffman, 1999, s 6). This statement presupposes that there is a clear difference between
the two. On one hand there is an aspect on culture as declared through the artefacts, and then also through technology, given in the culture. Artefacts are the culture, both as material and ideal, and artefacts are then not isolated elements of the culture (Cole, 1996, p 114). It is even suggested that since technology is everything in the world there is no such thing, but how will that help us to understand technology? This viewpoint may imply that culture and technology are totally emerged and whether an expression as "finding a connection between" the two, is possible, or even adequate, to answer is difficult to say (Ingold 1999, s vii).

Other researchers put the issue, perhaps not in an opposite position, but at least in another perspective. Anthropologists have tried to escape the study of artefacts and technology for some time, wanting to bring in the people and the social relations into the discussion. The problem has probably been the way the questions have been asked and how technology has been defined. Technology has for many years been connected with what is commonly called "material culture". This has made technology represent objects instead of practices and of artefacts and tools instead of processes. Still, studying technology tends to leave people on the other side of the boundary in the artificial division of people and things. When seeing people and things in performance, skilled human agents give the possibility to properly understand technology in the culture (Ingold, 1999, s viii). Technology is then serving as a medium through which social relations and world views are expressed and mediated, and where people’s attitudes about what is right or wrong in use of things are concretised (Dobres, 1999, p 128).

Especially for archaeologists there is a need to see a parallel relationship in technologies as acts of material transformation and technologies as acts of social transformation. Though, many ethnographic studies have shown that social control and power is strongly connected to material resources. These two aspects are then, at one and the same time, both for producing and using practical tools and social construction of power relations (Dobres, 1999, p 128).

It is therefore necessary to give technology a broad definition. Technology is more than just turning natural resources into cultural artefacts by sequential processes; physical artefacts cannot be separated from social relationships like knowledge, skill, context of learning, and also construction, interpretation and contestation of symbols and power (Hoffman & Dobres, 1999, p 211).

Technology could be looked upon in different levels. Technological research has, as already mentioned, a tendency to concentrate on objects rather than practices and on artefacts rather than the processes they are incorporated in (Ingold, 1999, p viii). Also, the technological act may not make any sense until it is related to the cultural, historical and personal: the goals, opinions and feelings of those people involved. The context is giving account for the use of technology by changing if the context is changing (Hoffman, 1999, p 105). The question I find important to add to this statement and also involve in the broad definition of technology is; "How did the act even come about?"

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**Artefacts**

The conception artefact is unambiguous in the meaning "product of art, artificially made item etcetera" (SAOL) or "something created by humans usually for a practical purpose" (WWWebster Dictionary), but on the other hand ambiguous when examining the border between something that is considered artificial and something that is not. In
the expression there is a balance-step between nature and culture – the nature as untouched and not influenced by people and culture as a space formed by people, created out of material from the nature.

The English dictionary gives further explanations that broaden the conception even more: "something characteristic of or resulting from a human institution or activity" (WWWebster Dictionary).

An artefact does not have to be a graspable, but can also be more abstract things. These are cognitive artefacts consisting of models and representations of what we do, of what we want and what we hope for, i.e. models for action. Scientific theories are perhaps the most highly developed ones of such artefacts, but representations of mathematics, literature and art should also be included (Wartofsky, 1979, p xv). On the question how these representations even are possible, Wartofsky brings forward two systematic issues – one analytic and one genetic. He states that the analytic issue concerns “how we are to understand the nature and function of a representation” and the genetic concerns “how we have been able to generate the very activity of representing itself, how we have come about to create cognitive artefacts in the first place”. He continues to argue that representation and construction of models is based in the very character of human practice. Making things and social action are then the fundamental form of activity and these two integrated are the necessity for our existence. The making and using of tools and language become the basic artefacts, which differentiate humans from animals (Wartofsky, 1979, p xvi).

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Technological systems as meaning and function

Technology is never an isolated item. Also, more complex technologies form complex systems. Looking at these systems one could roughly see a lower level of so called "hardware", where engines and mechanical artefacts form the base of the system. On top of it there is a level of "software", where the pieces are not necessarily mechanically connected. If using an airport as an example of a technological system the aeroplanes as vehicles are considered part of the hardware. Without being mechanically connected there are also other part as runways, people, skill and knowledge, etc that will form what could be called the software system (Constant II, 1987, p 228).

When looking at the concept technology it is important to note the purpose of the technology. If it is to be compared with other producing activities as perhaps creating art or writing a novel, the pure purpose of technology is then function9. Of course, an artist or a writer needs to use technology to be able to perform and refine his or her activities, but technology does not exist by itself just by being clever. A novel or a piece of art has a value in itself. If technology still is created without functional purpose it will soon be indifferent and fail. If studying technology and the technology is given a value of its own, the result of a work study will indicate strange results. Nordin uses the typewriter as an example to explain. If a work study at an office lifts out the typewriting as the most obvious activity it will point at a mistaken aspect of technology. The actual purpose of a user of the typewriter and the actual activity going on is lost in the material study of artefacts. However, wearing out typewriters is not untrue, since it is a by-product of the real purpose, but it is subordinated the actual happening in the office (Nordin, 1983, pp 46).

9 This is an issue of definition. I will leave this discussion for later. Here the reference makes a difference between technology and art in the broader sense, In later work I will happily discuss the dependence of art and technology and how these co-operate in both function and expression.
These side-effects that occur in technology-use are unforeseen and out of control of the people in the activity (Nordin, 1983, p 54). Technology development could therefore be seen as out of control. Emerging consequences lead to the thought of technology as “living its own life” (Nordin, 1983, p 54).

**Socially constructed technological systems**

For the past decade there has been a development into the field called the ‘sociology of science’; the sociology of knowledge has extended into the arena of so called “hard sciences”. Knowledge claims in science are then to be treated as being socially constructed. One example is the consideration whether the existence of n-rays or x-rays is scientifically “true” or “false” (Pinch & Bijker, 1989, p 18). Knowledge claims are then sought in the social world instead of the natural world. This social constructivistic approach implies that there is nothing specific about scientific knowledge, but rather a whole series of knowledge cultures, which must be explained through sociology and not through epistemology (Pinch & Bijker, 1989, p 19). Understanding is then, as I wish to underline, something that is both embedded and developed in the context that is the culture and the society. New understanding is then explained through new models, which are constructed in the activity.

I have decided to use the development of bicycle and bicycle use as an example in this thesis for several reasons. First of all, the artefact bicycle does seem at the first glance quite isolated – an artefact that was used by bicyclists all over the world. However, when looking closer, the vehicle, or rather the happenings around the vehicle, was very much a mirror of people’s thoughts, ideas and understanding. Conventions were affected by the new technology and new development in the technology was pushed forward by the conventions and also understanding of the technology. Actually, we are dealing with a complex system which was strongly connected to the society and also had a great impact on the same.

It is very important to understand how to interpret the example of the bicycle. It is not meant to become an example of an isolated artefact. Instead, the bicycle as an example will show that it is not an autonomous artefact, but its use and development is strongly connected to society.

**The construction of the bicycle**

With help from the early history of the bicycle I wish to use to point out how an artefact is connected to society, culture and history.

To my help I have chosen studies about the introduction of the bicycle, based on, among other things, contemporary magazines for bicyclists, which in their debate articles and letters to the press mirror the discussions that were raised about bicycling as an activity (Ekström, 1997).

Additional contribution to the material is provided by two authors - Mark Twain and Frances Willard – and their own stories about how they learned to bicycle, both very humorous and expressive (Twain, 1978 & Willard, 1997). Twain’s short story is about when he learned to ride a so-called high wheeler. It was written some time in the 1860’s, but seem not to have been published for the first time until the end of the century. Willard wrote her text right when she had learned to ride her bike in 1893. Willard learned to bicycle on a so-called safety bicycle, which had wheels with the same size. The text was published two years later.
I have deliberately chosen to give these two splendid authors great space in this thesis; to let them describe their contemporary experience in their own amusing and colourful words.

**The history of the bicycle**

The first bicycles came already during the 18th century and were made of wood. Both wheels were of the same size and they were often described as scooters. This construction exists all the way to the middle of the 1800’s, when the "high-wheeler", with a much larger front wheel than back wheel, were produced for selling. The bicycle was also called "The Ordinary" and became very popular. In the beginning it was considered being an exclusive fashion gadget, but was soon spreading to larger groups of users. In time, when the traffic was getting heavier, there was a demand for a safer bicycle and they were reverted to bicycles with wheels of the same size. This solution was possible thanks to new technical solutions. Parallel with these two forms, they were also producing three-wheeler for women and elderly people and also tandem bicycles (Ekström, 1997).

**Taming the bicycle –mentally and physically**

Mark Twain writes in his novel what happened when he was about to learn how to bicycle or "tame a bicycle" as he puts it. The word "tame" brings one’s mind to a bicyclist dealing with an animal. This is a very common description among the contemporary authors that write about bicycling (Twain, 1978. Willard, 1997), which also is obvious in the quotation from Willard’s short story (see p 31). When meeting the new artefact one often chooses to capture its features by using an allegory. Twain calls it, probably because of the high-wheeler’s characteristic features, also the steel-spider, but the most natural metaphor seems to be the horse. It does resemble the bicycle a lot, since it also is used as a means of conveyance for a single user. During late 1700’s scooters were made that even had carved horse heads in wood. Our two contemporary authors write about how they were thrown off the bicycle and how they in the end managed to hold the bicycle by the bit. Perhaps this could be seen as a trick from the writer to catch the reader’s interest. Nevertheless bicyclists are described in technical journals, by the turn of the century 1900, as bicycle-riders (Ekström, 1997) and terms like “riding the bicycle” and bicycle-saddle shows traces of an allegory that also was internationally widely spread. Also, this could be compared to the notion to give technology a life of its own.

Doing this direct transmission from riding was not as simple as it might seem. The current conventions brought matters to a head and created dreams, appal and debate. The bicycle is undeniably constituted different from a horse and society was questioning women’s right to bicycle. The problem with the dresses that reached down to the feet was on the horse solved by using a side-saddle. This technique was in trials applied to the bicycle by constructing a bicycle where the bicyclist sat with both legs to the left. A consequence was that the bicyclist practically had to be an acrobat and an equilibrist to be able to use it (Ekström1997. Pinch & Bijker, 1989)!

Except for the discussions about what dress that was considered female enough for a woman bicyclist, a great deal of the debate was about body movement. Bicycling could not be done as graceful as riding and this alluded strongly sexual and outermost unsuitable undertones. A sweaty body was solely associated with the lower classes of
society and it was therefore not suitable for a woman from the bourgeoisie (Ekström, 1997).

For women the usage of the bicycle partly became a tool for changing the existing social norms of society. The bicycle created a new world where mobility became a new concept. Geographical distances got a completely new dimension through changing the picture of the landscape and its accessibility to the masses. In the technical development that followed into the 20th century considerable changes in the view of women’s usage of bicycles and thereby also independence. Willard states that 30 years earlier (ca. 1865) it was impossible for a woman to move in public places. In 1895 it was still quite inappropriate, but not impossible. Willard writes:

"An English naval officer had said to me, after learning it [to ride a bicycle] himself, ‘You women have no idea of the realm of happiness which the bicycle has opened to us men’. Already I knew well enough that tens of thousands who could never afford to own, feed, and stable a horse, had by this bright invention enjoyed the swiftness of motion which is perhaps the most fascinating feature of material life, the charm of a wide outlook upon the natural world, and that sense of mastery which is probably the greatest attraction in horseback riding." (Willard, s 11)

Willard is by this mentioning several aspects of the users’ relation to the new artefact. Partly, the officer underlines in his saying that bicycling was not meant to be practised by women, partly the introduction of the new artefact created new dimensions for those that had become its users, partly it has segregated the society into bicyclists and non-bicyclists while it at the same time has erased former segregation patterns when considering that riding was reserved for rich people, and finally the text describes the widened view of geographical distance, the landscape and the surrounding.

In Handbok för hästvänner10 (Wrangel, 1978) the following text is to be found, which demonstrates the changing picture of women over time:

"The question is if an astride riding lady offers a beautiful or repulsive appearance can be left open. The eye has to adjust to the new picture. In those days when our wives and daughters for the first time sat up on a bicycle, one also felt shocked both here and there, just like one did even further back in time when viewing a lady that was skating, with strong displeasure. Or rather - one turned away the head to escape the abomination...If one has had the opportunity to see some of the capital’s most skilful horsewomen astride a noble steed, one has to admit that the equipage offers a completely harmonious and elegant picture. The lady that in a men’s saddle makes a hideous figure, does doubtfully look better in a side-saddle." (Wrangel, pp 146, 1978)11

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10 A manual for horse owners printed in 1887 and that is still in use today among horse people.
11 Swedish text in Appendix.
The bicycle in a changing society

When the bicycle came it was to most people a completely new item that had elements that could be recognised from older scooters and horse carriages of different sorts. However, it was its field of application that requested a metaphor that dressed it with the understanding that the user (and also other non-bicyclists) needed place it in the society. The bicycle came, as mentioned before, to be compared to a horse. This metaphor got the task to create a frame for the artefact, its size, its field of application, group of users and so on.

In similar ways would the new conveyances - bicycles, trains and a little bit later cars – be apprehended as a threat to the existing order of the society. Motion was a word that was considered very charged. This is traceable in the futuristic art that was dominant right after the turn of the century and which stressed dynamic, rapidity and machines in motion (Duro & Greenhalgh). Moving fast was associated with ill health. As late as the 1920’s one believed that the popular dance Charleston could cause renal failure and the youth was strongly advised against dancing that particular dance.¹²

The new lifestyle was in the beginning considered among the bourgeoisie being modern and exclusive, but soon it was accessible to wider circles. Both the high velocities that trains and bicycles could produce and the motion of the body when cycling was classified as vulgar and was regarded as strive against nature. There was a severe critic against what was considered rebellious and against what was provoking the existing values of the society. A founded anxiety and a general critic against the new times that the new technology bringing out was expressed by the ”bicycle-haters”, who wrote statements in bicycle journals by the turn of the century. They complained about, amongst other things, the great risks when travelling along roads with many bicyclists, and that they even disturbed the work of the farmers and scared the horses (Ekström, 1997).

Bicycles and conventions

In the Victorian Society one tackled the problems with the new technology in a way that we, in our times, cannot help ourselves giggling at. Would it not have been easier to let the female bicyclists dress like men, instead of constructing complex ”side-saddle-bicycles”, that nobody actually could use (although one created a certain kind of bicycle trousers for women they were still considered being emancipating)? And would it not have been easier to turn a blind eye to the conventions rather than producing bicycles with extra saddles for the chaperon? In the light of the current culture during the 19th century this would not have been adequate solution of those problems that many constructors struggled to solve. The view of the order in the society and conventions that maintain this order might be stronger than the need to take in the technical innovation.

One aspect mentioned above is the historical development that is making new behaviour ”possible”. Changes in practice parallel to technological innovation are continuously changing the order or the rules of the society. Douglas and Wildavsky argue that it is the

¹² An elderly woman told me this during a series of interviews that I conducted in 1995 for the county museum. The aim was to gather data about dance traditions in the region during the early 1900’s.
definition of what is "normal" that decides the "rightness" of interpretation, understanding and action. Different cultures have different normalities (This issue will be further discussed in the chapter Agency for Understanding). In the bicycle example what is considered "normal" is changing on several levels. The most visible one is women’s possibility to move in public places and doing physical activities. But also, there is a difference in access according to class. The fashion gadget goes from an exclusive user to a broader spectrum of bicycle-riders due to the development of the bicycle technology.

**Challenging the order**

If those people that were first with learning to ride the bicycle in the 19th century had had the power to decide if the bicycle should have been produced for the market, one can always wonder if we would have had any bicycles today. "The steel-spiders", as Mark Twain called them, were very difficult to learn to balance on and it was in many cases associated with outer danger to even try to mount them. Despite of this the early enthusiasts saw the enormous advantages that were offered and did, with a lot of effort, actually change their behaviour to be able to adjust themselves to the vehicle. Listen to this enormously humoristic, but very interesting, description about struggles between mind and body:

"The bicycle had what is called the "wobbles," and had them very badly. In order to keep my position, a good many things were required of me, and in every instance the thin required was against nature. That is to say, that whatever the needed thing might be, my nature, habit, and breeding moved me to attempt it in one way, while some immutable and unsuspected law of physics required that it be done in just the other way. I perceived by this how radically and grotesquely wrong had been the life-long education of my body and members. They were steeped in ignorance; they knew nothing - nothing which it could profit them to know. For instance, if I found myself falling to the right, I put the tiller hard down the other way, by a quite natural impulse, and so violated a law, and kept on going down. The law required the opposite thing - the big wheel must be turned in the direction in which you are falling. It is hard to believe this, when you are told it. And not merely hard to believe it, but impossible; it is opposed to all your notions. And it is just as hard to do it, after you do come to believe it. Believing it, and knowing by the most convincing proof that it is true, does not help it: you can’t anymore do it than you could before; you can neither force nor persuade yourself to do it at first. The intellect has to come to the front, now. It has to teach the limbs to discard their old education and adopt the new". (Twain, 1917)

When Twain is reasoning about this he has already passed a difficult and painful stage of trying to mount the high-wheeler, and he reflects upon the fact that natural laws on the ground, in the way he perceives it, does not apply to being on top of a bicycle.

When Twain describes his insights in his learning he is actually pointing out how he had to obtain a new view of the world. "His body" had earlier acted according to the surrounding in a specified way, a way which he had learned all since his childhood. In his trials in learning to ride the bicycle he his bound to revise his view of how the world
ought to function and also how it is constituted (or perhaps rather add, since he continuously also has to act without his bicycle) and through experience learn a new way. The bicycle thus, did not only contribute to further knowledge about transportation, but also a new view of the world came in its turn to influence what was brought to the world in the shape of artefacts and new technology.

The new view of the world demands an extended understanding by the user. The new technology must be understood in a new way; how the material and the mechanics work together and how these in the end create consequences and advantages for the usage. Willard writes how she had to examine the bicycle and construct an understanding to really understand how it worked and also in this manner became better at cycling. It is the technical skill, rather than seeing the bicycle as a wilful animal, that she finally may call herself a bicyclist (Willard, 1997).

"I finally concluded that all failure was from a wobbling will rather than a wobbling wheel.”
(Willard, 1997)

However, one can reason about what kind of knowledge that is actually needed. Willard will hardly become a bicycle constructor by her newly acquired understanding of wheels and cycle chains. I would rather like to assert that she has switched the transmitted metaphor for a view of the bicycle as its own concept, with its own technology, material and therefore also features. Whether these are “correct” in a scientifical or technical view is not actually interesting. The essential thing is that the picture that Willard creates for herself is necessary for her (and the group of people she is learning to bicycle in and is communicating with) to be able to carry out the activity she wishes to and is aiming for. Willard has been changed as a user. She is no longer the same uncertain, ignorant novice bicyclist that she once was when she mounted her bicycle for the first time. This change has emerged in the meeting and the interaction with the new artefact and in the changed culture that the bicycle is forming with other new phenomena. The bicycle as an artefact, on one hand, is designed for a specific purpose of one (or several) designers and this designer intent is not clear until using the artefact.
V. Understanding in a technological system of dialysis

Since dialysis treatment has an obvious air of technology concentration it is not surprising that discussions about caring and technology appear frequently in research about dialysis treatment. Nursing of dialysis patients is seen as a question of balance between "caring" and "being enframed by technology". This argument is perhaps justifiable in a time where development of technology is moving fast (Bevan, 1998, pp 730). Through my interviews and observations about nursing in a dialysis environment I would like to state a more complex standpoint. This perspective, however, calls for a more precise definition of the concept of technology, which I have outlined in the previous chapter. The reason for this is the necessity to see technology as whole systems, perhaps by examination of subgroups, but otherwise not leaving people and their intents separated from the physical material. I have traced three concepts I find important in this discussion – inheriting practice and understanding, science and practice and balancing complex technological systems. Through these three aspects I wish to outline three perspectives that all together bring out an understanding for how understanding may take different shapes within work practice in a system of dialysis treatment. Though, before going into these three, I will bring forward the issue of historicity, which is clearly visible at the dialysis department. Time becomes in itself a tool for the nurses, consciously or unconsciously, to use in the dialysis care.

Historicity at the dialysis department

Less physical things, like conceptions, beliefs or conventions blend together emerging new traits of the tradition. The way I want to present history in use in the work show three categories of aspects of history, which I find evident in the work at the dialysis department. The first one concerns dialysis as a process of treatment, the second one a specific patient being treated and the third one the use of history as a direct tool in the everyday work.

When studying and learning to become a dialysis nurse, the nurses have to learn about dialysis as a process for treating patients with renal diseases. The knowledge about dialysis as a whole is gained both through education and school, and through practising in a dialysis department, being lead by a more experienced nurse. First of all there is a longer history of the discipline based on the development of the dialysis as a physical and chemical technique. Tied to this is also the history of success and failure made by nurses in other hospitals. Accidents that have happened in other departments are brought into the practice as stories for reflecting and learning, pointing out delicate and dangerous parts of the work. This history is basically shared by several departments, although there might be local traits of the view of dialysis that differ. At one of my visits at the department the new water system suddenly stopped.
This caused an alarm in the wards and in the corridor. In some ten seconds almost every nurse was out in the corridor trying to find what was going on. The talk went “what is happening?”, “there is no water in my ward”, “put the machines in bypass!”, “everyone, immediately put the machines in bypass!” I could not help myself thinking about the terrible accident that occurred some 15 years ago in another hospital in another county when a whole department were affected by technical problems with the common fluid equipment and several patients died. One of the nurses told me that they do not think about these accidents every day or even every time something happens, but they are a part of the nurses’ knowledge.

In the department I have spent most of my time a nurse is responsible for two patients during a treatment beat. After a couple of months they will swap patients with another nurse. The history built in this case is connected to the patient. Every patient has his or her own history that is telling about what disease caused the damaging of the kidneys, how long he has been a dialysis patient, how his body copes with the dialysis treatment (for example how he or she reacts on low blood pressure or removal of fluid), how the patient’s health has developed over time, if the patient is in line for a transplant, if the patients has problems with alcohol, what kind of habits the patient has outside the hospital, and so on. There is a long and detailed history for every patient that is either directly or indirectly in the patients’ journal or known to the nurses through experience. This history is a local one known to the nurse in charge, but it is probably also known to most of the nurses at the department.

The final category is of a shorter temporal kind, which runs over a day or a treatment. When pricking the patient to connect him/her to the tubes and the machine the nurses get a feeling if this is successfully done (Svensson & Tap, 1997). This gives the nurse partly background knowledge to the alarms that will appear during the day. The nurse is building a view of how the process has been going, how it is running along and if it will be carried through as intended.

The machines are also involved in these three categories of process history. Through the usage of different machines and versions of machines this history is based both on education and experience. Different kinds of machines over time have made the nurses focus their calculations on different parts of the process.

Sometimes the machines will develop characteristics that are unique to the specific machine, though this was much more obvious with the older machines some eight to ten years ago, where some of them were considered extracting more fluid than other. This was well known by both nurses and patients. Today, there is more a question of a machine activating more incorrect alarms than other machines. Dialysis treatment is not yet (and might not be in the closest future) an exact process. All variables that are considered in the process are approximate. This is why nurses suggest that frequent alarms are due to the fact that new dialysis machines have a more precise and delicate structure and will not differ that much that it actually is noticeable.
History in all three versions may be used as tools in the work with treating dialysis patients. The overall historical view is very much a way of giving meaning and sense to the dialysis treatment. Patients cannot (yet) be cured. The nurses are aware of this and the ‘typical’ view of a patient might therefore be quite discouraging. There is no ‘well condition’ for the nurses to aim at when treating the patients. Instead they talk about a "better" and "more dignified" life. They are aware of that this is a problem. But if they compare dialysis treatment today with treatment five, ten or fifteen years ago they find that they have made progress and that they are on the right track. For example, nurse Margareta is part of a project, based on practical experience in treatment, that is aiming to investigate if extra supply of sugar will make the patients more alert and in better condition.

When an alarm is activated the nurse runs to the patient room to find out what is the matter. Nurse Margareta describes this as a total focus on the patient. She cannot see doors or walls on the way through the corridor. In her mind she is already there, by the patient, trying to figure out what the problem might be. The historical picture helps her to act. She knows if it is a problematic patient and if she needs to bring up the speed. Also, the history of the day might tell her what triggered the alarm and she is mentally prepared (Svensson & Tap, 1997).

The history of the day is constructed by moving around the department perceiving what is going on. Noticing the amount of alarms triggered by different machines or patients also strengthens this. This is a very useful knowledge since the alarms might cause synergy-alarms and it might otherwise be difficult to trace the original alarm.

Socially inherited practice

Even if the dialysis nurses have a long specialised higher education a large part of their knowledge is constructed through practice. Their theoretical knowledge is confirmed or perhaps settled by practical experience. The importance of experience is clearly underlined by the fact that dialysis nurses need at least three months as trainees at a dialysis department before they can take care of patients on their own. During this period of training nurses learn the manual operations in both care of patients and interaction with the machine. One could say that they inherit a practice from the nurse they are learning from. This is clearly shown in the example below.

During a beat the patient is connected to the machine with a vein needle and an artery needle. The force that is pumping the blood is twofold – firstly a wheel squeezes the tube in a steady pace and secondly the beat of the heart that pushes the blood.

When finishing a dialysis session the nurse has to disconnect the patient from the dialysis machine. In order to do this she/he has to follow a procedure where the blood that still is in the tubes on the machine, will be returned to the blood system of the patient.

When the nurse clips off the blood stream to the artery tube and disconnects it from the artery needle, the patient is only connected to the dialysis machine by the vein needle. To get as much blood as possible back to the patient the nurse connects the artery tube to a bag of saline that will now "push" the blood back into the blood veins. Since the artery tube now is disconnected the pumping of the heart is not helping to pump the blood around anymore. Here some nurses have developed a "trick" that will help as many blood-corpusescles as possible to get back into the vein; they bend the tube in their hand (fig. 4) and then let it go. This hand gesture is done at an even pace and
while watching it seems like the pumping of the heart is restored by hand of the nurse for the end of the session.

(Fig. 4 Sequence of pictures showing a pumping movement of the hand.

It is interesting to note is that all nurses do this hand-movement. This is something you do if you have had a trainer-nurse that did it. When I first noticed this handling with the tubes and asked about it nurse Lina said:

"Don’t write about that! It is not scientifically proved, but I believe that it is helping the blood-corpuscles getting back into the body"

One hour later I watched nurse Petra doing the same thing. She said almost the same thing, wanting me not to pay any attention to the movement. She could not actually explain why she did it, except that she increased the pressure in the tube by cutting of the stream for some seconds. Then, when she let go there would be an extra push in the fluid and it would make the process quicker.

A third nurse, Katarina, at the same department laughed when I mentioned the issue. Just like the other two nurses she said it was something you did because you had learned it during your trainee period. But she also added that it was something they had inherited from the time before they had started to treat the patients with hormone medicine. The hormone that is given to the patients today will help the body to rebuild new blood corpuscles. Now with this medicament it is not as important to get every drip of the blood back into the patient, she explained.

The fourth time I came across the issue was while I was interviewing the nurse from the third hospital, nurse Anna-Karin. She was also using this hand-movement when finishing a dialysis session. To her it was quite obvious ("she believed", as she added later in the discussion). She said that she can actually see the difference in the
membrane and in the tubes. While holding the tube and then letting it go she can see a difference in colour of the blood. It turns into ”strawberry juice” and she is then convinced that she is increasing the concentration of blood in the outgoing tube.

What I find interesting in this case is the way the nurses rely on this technical movement in their treatment. ”Scientifically”, as the say, they could give it up any moment. They have never seen any ”proof” that it makes any difference to the patient. But, at the same time they have developed a view of why they are doing it and how efficient it is. I would describe this as something they do ”just in case”. ”Just in case” it will be proved that it has some positive effects. In order to change their behaviour it seems like they have to change their way of understanding the process.

Also, the movement of the hands is a part of their practice; the way they are handling the technology when finishing a session. They do this routinely and stopping or changing the way of handling the artefacts will break this routine and make their experienced skill new and in a need of consciousness. This was obvious when I visited my main informant, Margareta, at her department. I asked her if I could ask some questions while she was working and she said it was fine. But this specific day she was dressing a new type of dialysis machine. She suddenly turned to me and said she had to concentrate while doing it. I watched her and afterwards I asked if it was difficult. ”Not really” she answered ”the machine is quite the same as the other ones, but there are small differences that I have to double-check in order to be sure that I have done it right”.

Anna-Karin points out that it is important to have experienced nurses at every shift. The younger nurses use the older nurses as a bank of historical knowledge. She talks about a scale of experience that she finds quite accurate for a dialysis nurse. The scale is based on how long the nurse has worked with dialysis and is as follows: After two years as a working dialysis nurse you have seen all routine situations, things that happen quite often. After three years you have seen the more unusual cases. And after five years you have seen it all – most likely. ”But that does not make you an experienced nurse”, she says. You might have seen some possible cases once during your time as a dialysis nurse, but how can you remember what you did last time? But do I even remember what I did then, and was it actually a good solution I came up with? This is why the nurses use each other’s experiences. For example, if you have a patient with an infected fistula: ”How do I go about it? How do I prick the patient?” This knowledge is not only due to history of experience concerning infected fistulas, but also the knowledge about the specific patient. The responsible nurse and the helping more experienced nurse bring their knowledge together. According to Anna-Karin this is a very important way of working. The experienced nurses are necessary to make the treatment and care accurate and safe. Also, it is very important for the patients to feel safe in their treatment, and that they are well taken care of, even if some of the nurses are less experienced than others. She describes it like this:

”A shift with only younger nurses is an unstable shift”.

In this way the inheriting of practice, knowledge and education is underlined, formed and practised in the group. The views of dialysis is confirmed, questioned, discussed, developed and then confirmed again.
Science and practice

There are constantly new concepts entering the dialysis department through new “rules” saying what is acceptable and what is not. Nurse Margareta talks about “truth”, what she and her colleagues consider being true about different parts of the treatment:

“Being true yesterday is not being true today...”

Margareta mentions two examples that directly come to her mind while talking about the issue. One is the fact that 330 ml fluid per hour was an absolute top level five years ago. They (doctors) meant that “the blood is moving too fast”. There were different reasons for keeping a lower tempo; one was that the speed of the blood would tire the patient and another one was that they believed that the diffusion could not work properly if the blood past too quickly by the filter. Today it is not unusual at all to let the blood move at a speed of 350-400 (or even 450) ml per hour.

The other example is about sterility. Today the need for some of the equipment to be sterile is not as strict as about five years ago. The restrictions from the hospital board are not as sharp and they usually aim at the nurses’ own protection against diseases. The experience is that infections are not more common today than before. Margareta found this change of practice very difficult. She felt that she might infect the patients that she would bring in germs into the patient ward. Soon she realised that there was not any larger amount of infected patients than there was before. Her view of infections and germs had to change. To nurse Anna-Karin this is a known phenomenon, but at her department the head nurse chose to keep the old restrictions instead of following the new suggestions from the hospital board. Just like the folklore researchers in the 19th century (see p. 9) Anna-Karin seems to “accept” the ruling paradigm. She may intellectually reflect upon her knowledge, experience and practice, but finds it necessary to accept a common knowledge to be able to do her daily work.

Questioning new facts

Handling the data in this project involves a consideration of a row of different aspects. There is a system of artefacts that are possible to distinguish and to find form and function for in the dialysis treatment. But there is also other data that is vastly more problematic to deal with. Firstly, there are ideas and perspectives from which the nurses form their own view of knowledge and practice. These are caught through rather informal and, most of all, prestige-less discussions about the work at the department. The nurses I have spoken to use expressions like “feel” and “believe”. In their work they feel that something is done the right way. When new ideas come to their knowledge, perhaps through new prescriptions from the doctor, they try this on their former knowledge, trying to motivate the rightness of their actions and of the new concept. This is how nurse Anna-Karin explained it:

“You always have to think for yourself and question the prescriptions from the doctor. One doctor once said to me when I was about to prick a patient: ‘You should prick there!’ He pointed at the fistula and wanted me to do as he said. My reply was: ‘Then you do it!’ I am the one pricking the patient and therefore I have to take a stand for what I am going to do.” ... some doctors believe that it is tougher to work in a
There is a reason for dialysis nurses to be seen as having strong opinions; Anna-Karin believes that it is because the dialysis nurses are the only ones that are able to connect the doctors’ knowledge with the knowledge of the machine technicians. For example, a technician might suggest a nurse to run a treatment where too much fluid is to be drawn. The nurse will have then opposed to this because of their knowledge about the treatment in general and the patients in specific. Also, a doctor might suggest an ultrafiltration with a small filter in too short period of time. The nurse, with knowledge about the machine, will immediately know that this will not be possible since the filter will probably be clotting.

This way of always adding questions to every new action is something she, Anna-Karin believes, inherited from the nurse that she had as a trainer. She described her as very skilled and pointed out that "one always has to make sure to get an answer to all the questions". She thinks that good nurses are the ones that keep asking all these questions about what is going on with the patient, the dialysis machine and the dialysis process.

Expressions that come with an air of uncertainty have especially caught my senses. They are not evidences of nurses’ lack of skill (although unskilled personnel also might be represented at a dialysis department), but rather the notion of the world being much more complex than it appears to be when talking about it. Sometimes even the first answer to one of my questions is clear with a "scientifically" formed answer, but when the nurse is asked to explain a little bit further the certainty turns into a hesitation. She then explained that this is where dialysis research is today and what practice and experience is giving them today.

**Dialysis – a complex technological system**

**The context of the dialysis system**

However, there is a basic problem in talking about artefacts and its context (See chapter Technology and artefacts in a social perspective). It is continually brought into discussions that place and consider an artefact in its right context, but often without explaining that an artefact in the highest degree is a part of the surrounding and therefore also shapes it. Steve Woolgar writes the following about understanding technology in its context in relation to other entities in the environment:

"...representations (descriptions, determinations of many kinds) of ‘what the machine is’ take their sense from descriptions of ‘the machine’s context’; at the same time, an understanding of ‘the context’ derives from a sense of the machine in its context. The sense of context and machine mutually elaborate each other."

(Woolgar, 1991)

Discussing dialysis treatment out of the perspective of the artefacts is a complicated matter. In the case of the bicycle we have a clearer single object with at some extent visible boundaries that makes it possible to lead the discussion towards a focus of the artefact, or rather; the example of the bicycle encourages us to focus on the artefact.
In this case, dialysis, we have a vast range of technology connected to each other in a complex manner. This complexity is not only due to how the actual objects are connected, but rather to what actions are taken in their use, and why they are used in a certain manner. The nurse’s aim is then to bring four different causes or consequences of urea and fluid problems into focus, trying to find a balance among these. Grasping this entirety is a feat in itself and it is, because of the limited time of the project, only done by the practitioners themselves. As an observer I still try to put the pieces together and new data is continuously giving new perspectives.

Focusing on a single artefact for an analysis may bring out some manageable frames for a discussion, but it is also narrowing and limiting the possibility to connect material artefacts to each other. In the example of the bicycle there is in one way a quite limited artefact. Perhaps there is not a technological system in the same manner as the dialysis department, but on the other hand, that example points out a complexity in understanding and in usage, which is forming a complexity. The artefact cannot exist and work in a society on its own, but is strongly connected to not just understanding, but also social order, gender, possible view of the world as a geographical concept and so on. This also applies to the dialysis department; however I want to focus on understanding in usage of artefacts in the system.

The advantage of using the development of the bicycle as a reference is that we now, afterwards, may understand the problem of grasping an understanding through witnesses of the activity (i.e. authors writing about their experiences in learning to ride the bike). A complex technological system, somehow, demands a focus on interaction and activity. The artefacts in themselves play a very little part as single objects, but in use connected to each other give for example dialysis treatment a totally different meaning – one that is totally focused on activity and the change of health (both short- and long-termed) among the patients.

The water

The dialysis department must be seen as a complex technological system. This has become quite obvious to me and to all of the other researchers that have spent many hours trying to capture and understand the concept of dialysis treatment and care. As mentioned above (chapter Technological systems as meaning and function) the technological system could, according to Constant II, be divided into two levels - hardware and software. In the mechanical part of the system I would like to present a complex interwoven technology consisting of several different technologies.

Starting with a basic element; the water cleansing system is pumping very large amounts of water up to the "water-plant-room". The water cleansing system is a proper miniature water-plant. The water is running through a system of filters, which will take away all possible germs and particles. The speed and amount of water, manoeuvring of valves, checking of pressure etc is controlled by a computer system that is placed in the centre of the room, surrounded by all the filters and the pipe. Adjusting the system or taking care of errors is usually done by first reading the small display on the box to the computer system. A couple of short rows of text that might say "V5" or "Kontrollera Permeatventil Y5" will give some help to find the error. The following step is then sometimes manual, done by opening or closing valves, or as I experienced once in the dialysis department, hitting a pipe carefully with the handle of a screwdriver. The department technicians mostly do this work, but if necessary the nurses will step in and handle the errors.
The cleaned water is then transported in the pipes called "the line" out to the patient wards. Here it is connected to every dialysis machine in order to construe the dialysis fluid by mixing it with a fluid from a can containing tailored balances of for example glucoses, different kinds of salts, water and so on.

### The dialysis machine

The dialysis fluid will meet the blood of the patient only separated by a thin membrane. That is where the actual cleansing of the blood is being done, where the diffusion of unwanted particles from the blood and necessary particles into the blood is taking place.

The tubes and the filter are attached to a dialysis machine. The role of the machine is both to help the heart to pump the blood, and control the treatment by keeping track of treatment time, measuring blood pressure, keeping track of the amount of fluid drawn from the patient, and keeping the set balance of substances that will be inserted into the patient etc. The machine does not do this by itself; it is set to run the process in a certain manner by the doctor and the nurse.

There is also a third item also belonging to the hardware part of the dialysis technological system – the alarm system. This system is mirroring the state of the processes that the other two parts are running and controlling. When something is leaving the predestined order the computer system of the dialysis machine will, if necessary, trigger alarms. The alarms may be displayed through flashing lights on the top of machine, sound from either or both the machine and through distributed speakers, and visually through a display system that is distributed throughout the department indicating the type of alarm and where it is rendered.

### Environment and skill

There is an environment that the artefacts are situated in, necessary parts of the system that are not mechanically connected to the other parts of the system. There is a physical setting of wards, rooms, corridors, etc that are making the process taking place somewhere in the world, giving all the necessary foundations like floors and walls, but also access to electricity and water.

The most necessary factor for the dialysis system is the people. It is of outer most interest that there are patients to treat, and also nurses, doctors and technicians to help the patients manage through the system, to make the best out of the dialysis process. The nurses are bringing knowledge and history with them into the setting, making it possible for them to make the right interpretations and decisions in the situations that may appear. They also have to have knowledge about the larger system that the department belongs to, i.e. to be able to form the unifying structure of administration and routine that is used inside the hospital. To do this, the nurses and the doctors have a set of tools like medical equipment, medicine, forms, office equipment, computers and so on. Here the nurses are dealing with a practice that is strongly connected to the community where they work, but also to themselves as individuals.

### The inner system

Descriptions of technological systems may usually end here, at the observable hardware technology and in its organisational software aspects of people and artefacts, for example an airport. But the nurses at the dialysis department have a third component, not yet mentioned. This is actually the core of the activity, taking place in the complex
dialysis technological system. I am referring to the patient. The whole point of conducting dialysis treatment is to bring a “chemical” system of a body to a balance, a balance of fluid and substances that normally is taken care of by the kidneys. This inner system is perhaps both hard- and software depending on what kind of perspective you want to take.

The nurses have to understand this inner system to be able to heave the damage that is done to the body by too much fluid and toxic particles. The nurses talk about four aspects to consider in the treatment. These are factors that she/he has to get close to in her/his work of decreasing the patients’ symptoms and the technology makes her/him analyse these, manipulate with them and finally get information about their condition.

The first one, nurse Anna-Karin mentions, is the one about the toxins that are transported throughout the whole body system. If not taken care of, the toxins will be stored in the body tissue and if not brought out they will cause physiological damages and will in short time lead to death. Toxins will even cause a change of personality, this is important to consider to be able to motivate the patient towards good treatment. Early dialysis treatment will then make it easier for the nurses to build a good relation to the patient. The toxins are "drawn out” from the cells out into the blood with help of medications to be diffused during the later part of the dialysis session. The first part of a dialysis beat is therefore a cleansing of the blood, while the latter is a way of luring more of the toxins out of the cells into the blood, and then have these toxins diffused in the filter.

The second factor concerns the balance of phosphate and calcium, which is supposed to hinder the patient from a decreased value of calcium in the skeleton. It is not uncommon that the dialysis patients easily get fractures. This problem is handled by adding a phosphate-binding medication, prescribed by the doctor, keeping the level of calcium intact in the skeleton. The patients have to avoid all kind of high-phosphate food, for example diary products. Here the doctor, nurse and patient can decide upon the best action to take.

The third factor is the amount of red blood-corpuscles. A dialysis patient usually has very low blood values, which is easily stated through regular blood tests. When nurses recall symptoms a decade ago they find that these symptoms have decreased. The problem has more or less been solved. Before, the patients were extremely tired and they complained about a lack of potency. Since those days a new medicine has been introduced. It is a hormone preparation that emphasises the body to create its own new blood-corpuscles. This preparation is taken as an injection subcutaneously 1-3 times per week.

The final and last factor is the left chamber hypertrophy, where the patient will develop a larger left chamber of the heart, because of the extra fluid in the blood that is exposing the heart to an increased pressure. This is a prophylactic work and the condition of the patient’s health is valued through tests and where education and information towards the patient is utterly important. Unless the patient receives a kidney transplant, it is very important that the patient keeps the fluid intake low, to spare the extra work of the heart.

The nurse can actually never see what is going on inside the patient’s body. There is a well-founded knowledge, which is scientifically based and which is learned through education during nursing school and further education. This knowledge is about the physiology of the body and the chemical processes that are in progress inside the body. During their learning nurses work with pictorial models that schematically describes the inside structure of the body.
Knowing if these actually are true is on one part done through a trust for the scientific knowledge that history of scientists have constructed over generations and that we in our culture take for granted is describing the world in an “accurate” way. On the other hand, the nurses confirm their knowledge through experience. This experience is based on the different ways of interpreting a patient. This is done by bringing a large amount of pieces together. There is the statement of the patient, registering of values from blood tests, the pressure of the blood measured from the upper arm, bodily symptoms like cramps, rashes, dizziness, headaches, heavy breathing and so on. All noticed, discussed and confirmed in the nurse community of more experienced nurses.

Together with the process of dialysis that the dialysis machine is making possible the experience of outcome is confirming the scientific knowledge. However, searching for answers helps in finding what resembles the scientific knowledge. Own experience of flexible systems gives an extra perspective.

**Rigidity and flexibility in the system**

If considering that artefacts are a way of extending the human body, the dialysis equipment could be looked upon in that manner. The kidney could then be seen as being an extended part of the body, connecting an extra mechanical kidney to the patient, or it could also be seen as an extension of the nurse, making it possible for her to reach into the inner system of the body. It all depends on the intent or the purpose of the activity. The artefacts cannot exist by themselves as isolated, autonomous technologies. They are there for a purpose, depending on the reasons for bringing the technology into the system.

 Neither part (machinery, surrounding, staff nor patient) of the system is rigid. Machines have a tendency not to do what is expected of them. They activate alarms that the nurses find unnecessary, since the machine cannot make the judgement of acuteness, and they sometimes terminate a treatment. These issues I find hard to discuss with the nurses. It seems easier to look back on the set of older machines they had before the reception of the current machines. At one department they remember the older ones as...
peculiar. For example, Tor and Freja (these were the names of the two machines) had a tendency to draw more fluid that they were set to do. Everyone knew this, even the patients, and there was always a chat about bringing the ultrafiltration down a bit to make sure that the machines would not cause unnecessary cramps.

The current machines still have problems, but not of the same kind, and the technicians serve and fix them continuously. The nurses do not seem eager to call any of the machines as specifically "good" or "troubled" machines. If this is due to the machines having more evenly scattered errors or that the digital interface is making them more impersonal is hard to say. Only one nurse talked about a machine (of the newer fashion) she experienced at another department. They called it a "Monday example". It had so many errors that it was soon taken out of use. But otherwise they could not give any "personalities" to the machines. And when I confronted some nurses with other nurses’ experiences of mishaps with the machines they were quite quick to blame the nurse. "She must have pushed the wrong button" or "she must have entered the values in the wrong order" were common reflections. Why Tor and Freja had "personalities" is interesting, since they had a quite similar inner system as the new machines, only an older version and not as exact as the new machines.

The physiological system of a person is not a rigid system that always will react to treatment in a certain manner. The nurse can very seldom define a patient’s treatment, start up the machine and the process and then leave and come back after five hours. Almost every treatment demands modification from the nurse. Cramps might lead to an adjustment of the ultrafiltration, just as low blood pressure or other disturbances in the process. The fact that the nurses have to be around the patients out of security reasons confirms that a risk always involved in every dialysis beat.

The nurses handle these flexible parts of the system in different manners – personal profiles or straight profiles. In the current dialysis machines there are possibilities to create profiles for every patient. These profiles concern three things - Sodium, Bicarbonate and ultrafiltration - where the nurses prescribe the ultrafiltration and the doctor the other two. One way of using a profile is to form a buffer of, for example, Sodium to help the patient through the cramps in the end of the session. In a similar way a so-called "sour" patient (containing large concentrations of acid) might be buffered at the end of the session with bicarbonate to counteract for example hyperventilation.

An alternative way to the above is to have a straight profile where the substances are equally distributed over the whole session (fig. 6 and 7).
These profiles are prescribed by the doctor, based on judgement of the patient’s conviction and values from tests.

The rate of ultrafiltration might also be manipulated. If the patient has a high level of fluid it might be wise to draw extra in the beginning of the dialysis session. The reason for this is that cramps might appear in the end of the treatment and keeping the ultrafiltration low might help to avoid them. On the other hand, as Anna-Karin mentioned, if a patient looses too much fluid in the beginning, cramps might appear earlier in the session. The heart will also be exposed to low pressure and the patient might not have enough strength to last through a whole session, since the heart might not be able to rebuild the normal pressure. Simply, the patient will faint.

Since Anna-Karin has worked in two different hospitals belonging to different regions she has the possibility to compare routines. The hospital where she has worked the last three years is using individual profiles for the patients, encouraged by the doctor and the head nurse at the department. The hospital she used to work at always used default-profiles (fig. 6). The reason for this was that they could not establish any differences through experience. I asked Anna-Karin what she believed, since she had worked in both systems. To be honest, she said, she could not find either system more efficient than the other. Sometimes patients get cramps, sometimes they do not, although she can easily favour the method she is currently using, since it is chosen for the department. She explains that the patient’s body cannot be seen as an isolated system where the outcome is totally due to the input. She illustrates this with an example. There was a patient that suffered severely from cramps several days in a row. The nurses tried to adjust the treatment but nothing helped. The patient was panicking

![Fig. 6](image1)

![Fig. 7](image2)
and after the first trial the nurses had to interrupt the treatment and let the patient come back the next morning. The following morning was not much different from the day before. The patient got more and more worried, cramps appeared and she panicked again. They had to interrupt a second time, but since the patient had stored a large amount of fluid they decided to let her rest for a couple of hours. The third time they started the treatment they were prepared and tried to ease the cramps with medical preparations. But nothing helped. The patient had again heavy cramps and suffered from pain and worry. They interrupted for a third time and let the patient go home. The following morning Anna-Karin was told to try again. The patient now had to have 6 litres of fluid drawn off due to the delay. This is straining the heart and it was necessary to make it work this time. Anna-Karin did not bother to tamper with the ultrafiltration profile, but used the same as the nurses had used the day before. Nothing happened. The treatment was running along smoothly without hardly any incidents at all, and the patient was relieved. Anna-Karin is absolutely certain that the patients have a "daily shape", which influences the process and is almost impossible to detect by the nurses when they start up the patient for treatment. It may be compared to how different it can feel from day to day if you go jogging (or some other physical training). Sometimes you feel awake and full of energy. At other occasions the body is slow and stiff and you cannot really explain why. The only thing the nurses can do is to be alert during the treatment and adjust the process continuously. The severity of the cramps might also be eased by building a relation of confidence with the patient, telling him or her that you are there to help them ease the cramps as quickly as possible. Negotiating with the patient about the process is a part of building this confidence. They might say, "shall we try this, otherwise we’ll change” or ”what do you think about today?”

**Trust of technology**

The nurses do show a very high level of trust towards the dialysis machines. This was not the case in the beginning, when the first computerised (or rather more computerised than the machines during the 1980’s) dialysis machines. The newer machines took over a great deal of the calculating involving weight, ultrafiltration and treatment time that was formerly done by the nurses themselves. Some nurses (among them Margareta) found it difficult to understand how the machine could do this correctly. In the beginning she would make her own calculation to check if the machine actually did what it was supposed to do.

*M: (She interrupts me) This I can tell you (she puts her finger in the air) has been terribly difficult. And I have worked here for a while. Eleven years. I have experienced another era when there were no... well there were some kind of computers already in those machines, but not like those today (she gestures a screen in front of her in the air). Then there were buttons and you had to calculate the pressure on your own. You had to decide and you had to do math to know what pressure would make the patient loose so and so many litres. Also, if you wanted to draw fluid you put a hose to the machine and it all ran out and I could measure the amount in a measuring glass. I knew: - Hah! Two litres. Okay. Stop!*

*A: Oh!*
M: Here I cannot see anything (she alludes to today’s machines, where the fluid goes directly out the drain).
A: No, that’s right.
M: It was terribly difficult!
A: It was?
M: (she nods). It was that I had to trust the machine to do the job.
A: That the machine handled the job you did before?
M: (she nods). It was a terribly difficult adjustment. Should I just accept this?! Because I simply cannot understand (she shakes her head), I do not understand the technology.

But after a while she was convinced. Ten or fifteen times of correct dialysis and she had to realise that the machine did its job they way it should be done. The difference seems to have been the physical security. In the old system the amount of drawn fluid was measured in a bucket, which made it easy for the nurses to both check and remember the outcome of the process. But in the new system the drawn fluid is only presented through a number on the display of the dialysis machine. The waste fluid goes continuously out the drain. It might seem like Margareta is blindly trusting the information presented to her by the machine. This is to simplify the problem; the nurse has also access to other factors to be sure that the process is going the right direction. The patient’s weight is always measured before and after a treatment and gives a rough but sure indication of the drawn fluid. Christel confirmed this by saying that she did not find the change of machines as difficult as Margareta did. To her it was much easier. She quite quickly found the role of the machine in the work that is as just another factor in her arsenal of information for making decisions. It is easier to trust the numbers when she also can, for example, judge the amount of fluid through the condition of the patient. She takes into account if the patient has been eating, drinking and if the patient has perhaps urinated before the treatment. The symptoms of low blood pressure or cramps during a dialysis session also indicate if there is a high amount of fluid leaving the body.

A third nurse mentioned initially having some troubles in understanding why the machine chose a certain treatment time or trans membrane pressure (TMP) when calculating the treatment. In the older system the focus of calculation was on the TMP. The nurses set the TMP and altered it during the session. Today they machines are fluid-oriented and the TMP is subordinated and will change according to changes in the other elements (ultrafiltration and time). The problem she had was that she was trying to handle the machine in the same way she handled the old system. She had to completely change her way of thinking about the machine and the treatment. Katarina explained that this was also obvious to the patient and they would relate their own health to the level of TMP. They usually had a TMP they found suitable for their well-being and the efficiency of the dialysis.

"Give me 50, that will work fine for me!"

was something you could hear a patient say before a treatment and they would be very sure about this. Today, when the machines are giving TMP a minor role focus is instead on weight and ultrafiltration. Instead the patients might say:
"I want you to take some more fluid today"

The reason for this expression could be that there will be a longer intermission until next dialysis session. Sometimes a patient also wants to have less fluid drawn from his or her body because of the experience from the last time when they had frequent cramps.

But the patient’s point of view might sometimes also be a problem. Determining the patient’s weight before and after the treatment brings the focus to the weight (instead of TMP as it used to be). Some patient’s are very accurate in their estimation of how the treatment should be set up, but in other cases the self-picture can be based on assumptions from a life without illness. Then it is difficult for the nurse to oblige the patient, since the weight of the body is a complex composition of body volume, fat, muscles, fluid, food, drinks and so on. Again the only tool nurses have is to inform and educate the patients about the consequences and to help them make the right decision. In these cases the patients’ understanding of what weight makes them ”feel well” is not an exact factor and is strongly connected to how they perceive themselves and their bodies.

The trust of technology has also been strengthened through more exact technology. The nurses experience an obvious difference between the older TMP-oriented machines and the newer ones. The new fluid-oriented machines have brought a higher degree of accuracy into the treatment. The sessions are smoother and the patients feel better in the long run:

"Before there was a lot of heads-down-feet-up”.

That is how Katarina expressed it. They had to step in and heave acute low blood pressure much more frequently than is necessary today.

Balancing a system

The nurses’ relation to technology is complex. On one hand they trust the dialysis machine as being safe and correct, on the other they always need to be suspicious towards the machine since it does not act the same way the nurses do, not being able to value a situation. On one hand they call for a strong engagement of technological understanding and on the other they point out to the younger nurses to always start their interpretation of the situation by interacting with the patient.

What I can see is a delicate balancing act in trying to use the technology as consciously as possible when grasping the inner and outer system of the patient and the dialysis process.

The knowledge that the dialysis staff possesses about the body and what processes it brings out and is exposed to is both a certain and an uncertain knowledge. But this knowledge does not stand alone; it is firmly connected to the knowledge of treatment technology. And this is a subtle work of balance. On one hand the technology is the single tool to turn the health of the patients from a quick death to relatively good condition and the possibility to have a normal life outside the hospital. As mentioned before, treatment of renal patients within the regular medical care did and could not in any way ease the symptoms, to achieve this there was a need for a technical advance in treatment. One could say there is a difference in dialysis care and dialysis treatment.
Hospital care would not help the patients in any way. As Anna-Karin puts it: “it would even make their suffering worse.” This since the toxins in the organs would without doubt lead to a quick death. New technical advances in the treatment, on the other hand, were the only way to make patients better. However, the development of the dialysis treatment has in large brought the focus to the technology and successively changed the access to the technical part of the dialysis process (Fagett, 1999, pp 379). This is how Anna-Karin explained her relation to the technology at the department:

“You will never become a good dialysis nurse, unless you’re interested in technology”

Persuading the patient is a difficult task for the nurse. Not only is the inner system of the patient physically out of reach, the control of the system is not in the hand of the nurse but rather in the patient himself. If he or she consumes too much fluid between the treatments the nurse has no tools to change this fact except from giving information about the risks. The patient’s actions between the hospital visits are crucial in this case. The only intake the nurse is in control of is the one during the dialysis session.

There is a notion among the dialysis nurses that technology in the dialysis treatment is drawing focus to itself, like calling for attention on its own. All the nurses I have talked to make this clear over and over again (this is one of the few things where they seem to present the very same view). As a nurse you always have to take your step-off by the patient, that is where your first indication on how to act is coming from. You deal with the patient about the treatment; listen for the statement about their condition and their wishes about today’s treatment. If they try to decrease the length of the session it is up to you as a nurse to motivate and explain and also warn for the consequences. Of course, there are times when the patient, because of the disease, has a hard time to realise the effects and the necessary cause of action. But still, the nurse cannot violate the patient’s will.

The nurse has the results of the blood tests, the values on the screen of the machine, the knowledge about previous treatments and in one perspective also the outcome of the coming treatment. In other situations where the patient has a difficulty in understanding the process, for example at incidents, the nurse points out again and again that they have to underline the importance of always looking firstly at the patient and then at the machine. The machine does not always indicate the condition of the patient. The screen on the machine is rather there to confirm what you see by looking at the patient. This may sound like the nurse does not have any trust for the technology at all. On the contrary, through experience they have learnt the functions and the limits of the machine. They have a founded knowledge about the technology they are working with. This technological knowledge, though, does only partly focus on the structure of the machine. They seem to separate the pump and the tube mechanisms from the computer mechanisms. Here the knowledge is founded in what actually happens when treating the machine in different ways. And these actions lead to effects in other parts of the system. Anna-Karin, for example, may, what she says, “experiment” with the machine, by doing the different steps in different order. But this way of tempering with the machine is only possible if she knows what will come out of the action. And the outcome may cause her to take actions towards the patient.
"If I do this, the machine will do that, and then this will happen to the patient. And then I have to take an extra blood-pressure test."

It is important to mention that this kind of "experimenting", trying to find new ways with the machine, is done in co-operation with the doctor of the department, and it must always be done by comparing actions to former experiences and actions taken before. She says that the machine is "idiot-proof". She trusts the safety of the machine, but it will still only do what it is built for. Though, Anna-Karin points out that trust of the machine concerns only the machine. The machine is built only to describe "its own little world", and when there are "outer happenings" the situation is completely different. Things that happen outside the machine bring in new parameters. For example, if the vein needle falls out (or is pulled out, if the patient is panicking) and is leaning its point towards the sheets there might not be a change of pressure in the needle. The patient might not be sound enough to be able to understand what has happened and push the alarm button. This depends on how narrow limits the nurse has chosen for the vein pressure. Even a needle that is lying openly in the bed might not, because of wide vein limits, be noticed by the machine as an alarm situation. The machine does not measure if the patient is losing blood, but only if the pressure is kept or not. Anna-Karin says that they almost every time, for safety, choose narrow limits, even if they will cause alarms when the patient is coughing or turning a page in their newspaper. This is why nurses are so important in the dialysis treatment. They cannot simply start a treatment and then let it go until it is time to close the treatment.

Other nurses may see the machine like having its own life. During my field study I observed a nurse priming (preparing for treatment) a dialysis machine. There was something wrong and she explained:

"It did not give me the symbols I wanted"

The technician was called to the ward and he started to look it over. They were discussing the problem.

Nurse: It should be able to take some faults [mistakes done from her side], shouldn’t it?
Technician (mumbling): Yes, perhaps a few.

The probable cause, I was told, was that she had entered some input in the wrong order (the machine was finally taken out of use later that morning).

These statements could be seen as two examples of two perspectives in the daily work. One, which almost everyone might be able to refer to in some way, that gives the technology a life of its own, and another which more or less reminds of a stupid, but accurate, machine.

The nurses talk about raising questions all the time. And most importantly of all they try to get these questions answered. Anna-Karin believes that this, and the lack of comprehending the possibilities and limitations of the dialysis machine, separates the skilled nurse from the unskilled.

They do "trust" the technological system. Security has increased dramatically when bringing in the digital technology into the dialysis care. However, this "trust" is somehow rather unfaithful. Again, the machine is only acting upon the restrictions it has
been set for and Anna-Karin finds it necessary to always be suspicious towards the machine. The machine is "not 100%", it will not be able to handle all activities happening on the "outside", for example, if the patient decides to pull out the needles (this is not common, but it has happened when a patient has been panicking).

In order to point out both these sides - *enframing or being in control* of the technology - I will here present a delicate example of an episode, which was narrated to me by Anna-Karin. The story underlines the necessity to refer to several kinds of historicity in the work.

There was a patient that was treated for quite some years. The patient suffered from several heart attacks and was in a very bad shape, waiting for an operation. The patient was carefully watched by the nurses. However, the patient died of a heart attack and the nurse in charge did not notice the situation quickly enough, since the machine was still running without indicating that anything was wrong. A second nurse quite quickly noticed that the state of the patient and the state of the machine did not coincide.

There are several questions that come to mind while studying this incident. How did the interpretation of the nurses differ, and how was this possible? And most of all; why was the machine still running even if the heartbeat had stopped?

It is true that the patient did have a known history of heart attacks. This was probably known in the department; other nurses had come across this or heard other nurses talk about it, probably through the talk in the lunchroom that seem to be of outer importance for the nurses to be up to date on the situation in the department.

The nurse talks about "recirculation" when telling this story. Recirculation is when the blood in the fistula never leaves the fistula, but is repeatedly going back to the machine, from vein needle to artery needle. She says that she has also experienced this phenomenon. At the same time she says that it is impossible to explain what actually was going on. How did the machine keep on running? Recirculation might appear when there is a constriction of a blood vessel in the upper arm, but hardly when it is further into the blood system. Perhaps the pressure in the fistula was kept for some other reason. The point, she says, is that we cannot find out the actual reason.

Here we have several factors working at the same time. The history of the patient is something that the nurses have built up through weekly care and treatment of that specific patient. They have seen him in many different conditions over the years and knew what signs they should be looking for. The historical knowledge the first nurse was carrying was not adequate to make the same interpretation as the second one, and the second nurse seemed also have, parallel to the patient, built an understanding for the dialysis machine. She knew its limits and its characteristics, just like Anna-Karin is suggesting. For example, it did notify her about alarming situations by triggering a sound- and display-alarm. This happens several times every day in the nursing of the dialysis patients, and she had to some extent trust the machine “to do its job”. And it actually did, even at this incident. The machine is constructed to give notice when the values of, for example, blood pressure go either above or below a certain set limit. At this time the machine did not activate the alarm because the blood pressure was still kept at an acceptable level. This is a problem that is known to other nurses. Even if it was an unusual occasion this time, the nurses are asking for a way of indicating low blood pressure at a much earlier stage than done today. Nevertheless the nurse’s interpretation is still an interpretation. She can never be sure that there actually is a recirculation in the fistula. Her understanding is built upon experience and scientific knowledge.
Agency for understanding

Mary Douglas and Aaron Wildavsky (1982) have in their essay Risk and Culture put the light on how modern society and modern technology seem not to have taken away people’s way of thinking about nature, even if we do find it that way. Their claim is (amongst a couple of other standpoints) that knowledge about the world and risks and action is out of sync. There is a substantial disagreement of what is risky and should be done about it (Douglas & Wildavsky, 1982, p 1). Our society with modern science and technology has diminished the mystery of nature. In other societies before us nature is politicised and accidents or diseases are given a meaning for its occurrence. Our way of thinking has during the 20th century by modern philosophers meant to be differing from primitive way of thinking. For example, modern thought includes accident rates and the normal chances of taken ill with a disease. The key concept here is normality. How does the society define what is normal and what outcomes are to be considered normal? New technology has changed our way of defining what is normal. New social responsibilities are produced and provoke new culture evaluation. The blame in illness and death varies from culture to culture. In our society a child may have chickenpox or teething problems without having to face guilt, this because these complaints are considered normal for children. Normal accidents can then be seen as part of nature; it is not likely that every hunting expedition ends without an accident or that every crop is spared from pests and drought (Douglas & Wildavsky, 1982, pp 29).

In the discussion of responsibilities for accidents and diseases there is a risk agency distributed in the society. Douglas and Wildavsky reason about the American society where a doctor has a stronger role of blame in treatment failure than his colleagues in Europe (Douglas & Wildavsky, 1982, pp 29). I would like to bring this concept of agency further into the picture of dialysis treatment and how it is connected to inherited understanding. When trying to understand technology as artefacts, participants and processes the nurse has to construct a reasonable explanation in order to relate to her former experiences and the feedback she is receiving. In this manner she is dividing roles of responsibilities to parts of the system of people, technology and work. It could be described as forms of agency constructed for the nurse’s own reasons. These can be personal, but also be declaring the common order of the group or culture she is belonging to. In Douglas and Wildavsky’s words the agents could be seen as the objects to take the “blame” for forming a certain understanding.

In the case of the patient with the dramatically low blood pressure the nurse added several factors to her interpretation. First of all, she had the historical knowledge about the patient, which gave her the reference for interpreting the patient’s body. Secondly, she had a historical knowledge of the machine, its limits and possibilities, which gave the background to the suspiciousness of the behaviour of the machine. And finally, she had knowledge about physiology and the structure of the blood system, which has been learnt both through education and experience in work with handling fistulas and studying X-ray-pictures of the patients. These three agents all contributed to the forming of the interpretation of the situation. When considering the other nurse that did another judgement, the agent (represented by the patient) was not adding to the reasoning in an adequate way. The reason for this might have been in the failure of bringing the patient into the picture, letting the machine steal the focus from the situation. But it might also have failed because of the lack of historical knowledge. Her experience of the patient might have been minimised by the fact that she had only experienced the patient’s characteristics by few sessions of treatment or perhaps just by hearsay. Anna-Karin’s statement that a young shift is an unstable shift underlines this clearly.
V. Towards design

This part of thesis is an attempt to direct the issues towards the activity of design. Design with the objective of creating something to change a practice or perception of a practice is design for specific work practice. In this chapter I take the liberty to form my own ideas and thoughts. This is why literature references are scarce. However, my thoughts all rest on what I have presented so far in this thesis. Understanding design is, in my view, an experienced knowledge, and my standpoint takes its aim from my view.

Depth ethnography

As I mentioned in the chapter about method I have used ethnographical inspired methods in my study, although I have not been structured or even faithful to the discipline. Ethnographical methods are successfully used in design related activities, but as observing activities I find them quite shallow. In my sense of understanding a part of the living world I cannot understand it if only taking out a slice – even if it is a slice of time, space or political or social structure. To me it is obvious that it is necessary to give a depth to the picture.

How can a slice of “now” give us good design for the future? Well, we do not actually know. The only way is to create an understanding for change, how technology becomes embedded in culture and society. The historical perspective becomes then unavoidable, since that is the only way we may know change.

The purpose is not to let a solid ethnographical study become evidence about a vast system. It is not in this scenery meant to be serving as description of a complex system. Working with design demands coming to a conclusion, or a tangible “proof”, of a final reflection. I argue that one way is to find agents that may form the change of understanding, behaviour and action. These will then work as keys into the creation of new design. To form questions that must be revealed specifically depth ethnography necessary. Depth ethnography allows the designer to focus on certain issues and form an understanding that goes beyond a general description. Methods that are necessary are logging and participation. Only interviews, which I find common in IT-design today, are not enough to form a deep understanding of a culture, simply because a description of what is going on differs from the complexity in the activities of the system.

“How is this even possible to comprehend?” says perhaps the inexperienced historicity practitioner. My understanding of the practice is that it actually is a handicraft necessary to learn and train, to understand a complex development. In my view, through my experience of design and creational activity, one has to adopt this practice to actually be able to conduct and execute creational work. An artist may find his or her agents through inspiration, while the designer must find their agents close to the users and their cultural and social circumstances.

Focus on “software”

All technology is a part of a larger and more complex system. It was hardly solely the bicycle that gave women right to vote. But people do have problems to grasp something
that is going on at several levels and in different times, and therefore tend to simplify by dividing systems into single objects. This makes it necessary to state that if focusing on the artefact, either the bicycle or dialysis, I might do just the mistake I want to avoid. It would be a way of simplifying society to make an artefact the agent to a cultural change in society – the system is much more complex than that!

If so, there is no doubt that the only way to grasp interaction between people and technology is to try to study systems as complex systems. At the same time I am aware of the problem; even I have to admit that I have in some ways failed while doing this study. I have as mentioned, excluded for example gender and in some ways also politics, which are very important issues indeed. Especially politics is quite visible in the dialysis context. I have already mentioned how “a new truth” appears from above in the hospital hierarchy, but I have also come across the knowledge and opinions of when a patient should be taken into treatment. In low economic conditions several nurses claim that the hospital board finds it better for the patient to wait as long as possible for dialysis treatment. The reasoning is that dialysis treatment is so tough for the patient that he or she should be able to “go the golf course” as long as possible. On the other hand, a good economy shapes thoughts that a patient will be sounder if taken into treatment during the early stages of the illness. Lack of money is not solely forming these situations; the perspectives are differentiated and still not yet settled within the dialysis community.

The process in motion that is continuously going on, for example in the dialysis care, tends to make the system into an organism that makes technology have a life of its own, and it is the nurses’ job to question and understand this system. The emphasis must then be to take focus away from frozen artefacts and instead put the light on activity and interaction. This is only possible when considering a whole complex system, where knowledge and action considerations are tying the system of material artefacts together.

In this perspective historicity makes design a complex activity. Historical change has in this study shown to be of outer importance. The nurses’ knowledge is not a static factor, and most of all, it changes quickly. The nurses (together with their patients) are all participating in tests and trials to find new solutions for a better treatment of dialysis patients. The influences come from several directions; the doctors bring new ideas with them from conferences and meetings with other doctors, the hospital board give new directions in use of resources and nursing activities in general, and, most of all, the nurses experience new things continuously in their daily work. All these things contribute to changes in their standpoint towards their work activities and their role as dialysis nurses.

In order to be able to grasp this, I need to look at understanding – how it is shaped, inherited, how it does come about, where there are tensions in knowledge and how they do interact. This is where the scientific knowledge is valued against experienced and inherited understanding in the treatment as a practice.

Decision making is always taking place in a historical context, this since knowledge is embedded in the culture and is both general and local. The nurses use it to understand progress in their work, when they can compare the result in their work with former work and also work done by nurses before themselves. However, there are several parts of the system that the nurses cannot come in contact with without forming an explanation; they cannot see, hear or feel what is going on. This is when they use formal, common models to understand the work. Or they might also take a reluctant
standpoint not being willing to find a settled explanation. They will keep the options open and reason with doctors, technicians, other nurses and also patients.

I find an interesting notion of ambiguity where practice that is inherited seems to be much more rigid than the experimental work of developing new treatment. Perhaps is the rigidity due to work practice and therefore activities that are connected to the movement of the body. On the other side there is the issue of uncertainty which is questioned, discussed and tried out over and over again in the daily work.

There is no straight way forward towards “good” treatment with cured patients. Instead there is a great demand for local knowledge and ability to use history to understand the value of the different results. The efficiency that is created is not at all what is commonly known as efficiency. There is a notion in our western culture about people, that they do everything cost efficient. People are supposed to save time, money, space, on so forth. If efficiency was easy to understand knowledge would be static and precise. This is not the case, and this is perhaps a relief; in the nurses ambition to be able to understand what is going on they are continuously refining their practice. Also, the trust in technology and in knowing how to act is to great extent shaped in the meeting with older and more experienced nurses. There is some kind of efficiency, although it is connected to conducting treatment and care aiming to make a patient as well as is possible for the moment compared to yesterday, last year or even a decade ago. The ideas of treatment are therefore clearly connected to history and time, where activity and efficiency is relatively measured.

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**Bringing ethnography to design**

While examining all these issues every context of a setting turns out to be so complex that one might loose the sense of using ethnographical methods in system design. Still I cannot see that there are any other methods than ethnographical ones that put the user within reach of the designers.

If design is totally disconnected from concerned people it will act isolated with laws that are only rectified by the design itself. If so, the function has left the scenery, the technology has created its own value and is solely a piece of art, telling its user something, but it is unclear whether it is telling what it was meant to.

In the eager to create something “good” for our society we tend to make the world clear and obvious. One of the traps with ethnography is the tendency to make work practice into elegance. Ethnography is in its practice a way of capturing an on-going practice and analysis will then create an understanding and a model of that same practice. Ethnography has some given assumptions that it brings out pictures of “good” practice. Malpractice and other practice related problems are kept from the scene and easily forgotten. In my study I cannot say that I have avoided this completely. However, since one of my informants was close to me before the study I have had the opportunity to discuss problems in practice on another level. She has talked about performers that are difficult to work with, performers that either use the system for private politics or have problems in communicating with others. She has talked about unskilled (although experienced) performers not interested in technology learning, practitioners that view technology as if it actually could take adequate decisions for them. Coming back from a session with my friend, talking about malpractice, I suddenly realised that I had been creating an ideal, and perhaps even romantic, picture of the objects of my field study. For months I had built up amazement, deeply impressed by the way the nurses handle this complexity with well trained skill. My viewpoint was naïve, since I realised that I had my own workplace experiences of colleges with low skill, mistrust and private
politics. However, this turns out to be an interesting issue with several perspectives. Once again there are other forces to behaviour and action than the rational once (or what is officially known as a rational in the setting). How do we handle this input to do adequate design? The complexity is due to the “software” part that is connecting the rather rigid “hardware” parts. A new designed tool may or may not help or satisfy the current software system of understanding, deciding and also acting. A design may then, consciously or unconsciously, be formed to block, or avoid, parts of the system.

This, I believe, has made it easier for me to see these parts of dialysis work. Here the most experienced nurse might not be seen as the most competent one, which has formed a work community where there might be mistrust and also questioning of practice in the daily work. These issues would have been impossible for me to detect while doing ethnography, since I as a layman could not understand them while watching the work among the nurses.

Design is always an activity of creating, building or shaping some kind of “material” into something new, which is supposed to be used in a future. Here I see a problem for people that discuss computer science. I have come across researchers within this field that argue that computer technology is unique compared to other technologies. The differences would then lie in the fact that computers are interactive. This I find quite disturbing. First of all, history shows us that other technology just as computerised interactive ones creates a notion of life. Even bicycles seem to act like animals with their own will, throwing off their masters. Dialysis machines draw attention from the patients; they are seen as being able to “give” the user something by just understanding the input, although it is inserted into the machine in an improper order.

Interactivity is not created in the hardware itself, but in the software, in people’s minds, understanding, history and practice. Design must then be aimed at software, which is a very difficult notion to grasp. The proper understanding for the technology and the use of technology must then lie in trying to grasp this complexity or at least be aware of it.

This is the main reason for me to treat technology as a whole and not specifically wash out computer science in the discussions. It would have made a study of the dialysis department and the work practice in dialysis care impossible to even carry out. Computers at the dialysis department are important. Without them dialysis treatment would not look the way it does today. But, without the rest of the technology the computers seem almost ridiculous. They could not achieve anything on their own, without the knowledge and understanding that the nurses have learnt and inherited through historical and own experience. Just like Anna-Karin says, the computers are built for “their little world” and are quite correct in that world, but when bringing in the outside activities of the new world it all turns very unstable.

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**Bringing time to design**

Design is dealing with time. Time as now, when it is perhaps possible to understand what is going on, how people act, how technology is used, how decisions are made and what wishes people have about their lives. Time is also later, creating something for a future society, when we interpret what people will need in a future, how people will behave and how they will understand.

The perspective of time is very seldom mentioned in ethnographical work. There is an obvious choice of here-and-now-study, which does not involve the time perspective.
This could also be applied to space. I have conducted my studies at one department with complementary visits at another. The third department, which was involved only through interviews with Anna-Karin, I never even visited. How could I even be sure of having seen enough, or the right place, people, actions or whatever? Have I even tried to get close enough in detail? In some cases I might have, in others not. In my case I was not aiming for a design outcome, but how would my choice of focus have affected a design situation? Here it is important not to forget the power of the designer. In the creative skill of design lies an ability to go beyond current perception and find new perspectives to work with, a capability in bringing a platform to create visions from. And the tools for the designers are to be found among the “agents” that form change of understanding in the specific culture.

Technology always has to go with knowledge about the technology. Technology lies then in the knowledge of the usage rather than in the construction of the tool itself. Designing tools is then not an urge to form artefacts that bring out users to do this or that. Design must be entirely connected to the inherited knowledge of the activity, the practice in itself.

Use of technological systems is depending on the understanding of the system and the intent of using the system. Both examples of practices in the thesis, bicycling and dialysis treatment show that understanding the system is a necessity to be able to use it and also learn in it. But, it is not necessary that it is a “correct” understanding. The model for understanding a user forms one understanding that either goes with the common knowledge in the co-operative group or something that gives the artefact a place or intent.

Many of these issues are not visible until time has passed; when traces of events, changes of artefacts, memories and narratives are washed out and leave some sediment to reflect upon. Working with future, which actually is every developing process in our daily lives, is a handling of history. This is either made with consciousness or not. This is Work Practice; where activities are not formed in some kind of assumed rationality or efficiency, but rather in the historicity that comes with the culture.

The understanding that is formed around a practice or culture must be perceived as common for the very same society. This is a viewpoint that is quite well known among ethnomethodologists. This was something that appeared clearly in the dialysis departments. But there were also diversions among the nurses, which was very well known and reflected upon. Perhaps it is the rather new and delicate activity of treatment that has made the nurses open to all kinds of discussions. The practice has only been developed over a handful of decades and may therefore still be changing in its foundations. Maybe the severe accidents that have occurred show to them that well established routines and understanding may as well be totally wrong if a few factors for some reason are changed.

This knowledge, I believe, is very useful in design, when creating new technology for an ongoing activity. People strive to find meaning and understanding in everything they do and the designer needs to find out where this strife is heading and react to its changes. The historical path of the developing understanding will give answers and must not then be deliberately put aside. People and their activities are then much more plastic in their changing than artefacts. People’s mindsets and understanding will much more easily change in the use of an artefact (or technological system) than going in and actually rebuild the artefact. Changes in artefacts are always a very slow process. When looking upon historical examples, changes in forms may be done over hundreds of years and these changes may not always be significant or rightly interpreted. People on the
other hand are much more adaptable, they try, they reflect, they accept. But in the end, this will, in many cases, be quite time consuming and inefficient for the activity going on, and also in some cases, like dialysis, a balance between life and death. Maybe this sounds awkward. People are known to be conservative striving towards static balance and security. Maybe so, but I believe that this is exactly what makes people work around the obstacles they meet through artefacts. Instead of pulling up the roots to redesign the concept, they form themselves and their activity to satisfy the common system. This is important to understand as a designer; how the common culture gives a framework to behaviour and understanding the activity.

Finally, I will make a small comment on the title of the thesis – Willing Technology. The title is a play with words. The associations for different readers probably refer to different things. The most obvious one is “will” as inheriting, like what is hinted in the subtitle “inheriting understanding and practice in a complex technological system of dialysis”. But willing could also be seen as a technology that has a somehow human urge to serve, and in this specific case serve dialysis treatment. However, it could also point at the fact that people might or need to be willing about technology to be able to exist in a developing culture. Technology is many times directly connected to feelings that disturb the state we are living in. Technology is not only blamed for being “human”, as in the examples in this thesis, working deliberately against the user, but is also the scapegoat for things in society that is perceived as uncontrollable and also bad for the balance in the culture.
IX. References


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X. Appendix

Original texts
Smålandsposten, 1884:

-Ytterligare fullt tillförlitliga meddelanden om Dragen eller Lindormen emottages med stor tacksamhet.

Den som på Sunnanviks gård aflernar ett dödad exemplar af nämnde Orm undfår en belöning af Ett Hundra intill Ett Tusen kronor, i mån af exemplarets storlek och öfrigas beskaffenhet, så snart detta, i tätt laggkärl med påhäld sprit eller bränvin eller ock nyss dödadt, aflernas till undertecknad. (Smålandsposten 1884)

-Wrangel

"Frågan om en gränsle ridande dam erbjuder en vacker eller motbjudande anblick kan lämnas öppen. Ögat måste vänja sig vid den nya bilden. På den tiden då våra fruar och döttrar för första gången satte sig på en bicycle, kändes man sig också shockerad här och hvar, precis som när man ännu längre bort i tiden betraktade en dam, som åkte skridsko, med utpräglad ovanlig. Eller rättare - man vände bort hufvudet för att slippa se styggen...Har man haft tillfälle att se några af huvudstadens skickligaste rytarinnor gränsla en ädel springare, måste man medge att ‘ekipaget’ erbjuder en fullt harmonisk och stilfull bild. Den damen som i herrsadel gör en anskrämlig figur, tar sig säkerligen inte bättre ut i damsadel.” (Wrangel, ss 146, 1978)

Dictionary

Trans Membrane Pressure (TMP) The pressure that is set to the blood in the tube. By increasing the difference of pressure between the blood and the dialysis fluid (if the pressure of the blood is higher) water in the blood will move over to the dialysis fluid.

Ultrafiltration (UF) The physical process when fluid is transported through a semi permeable membrane. In dialysis care the process to draw fluid from the patient.

Fistula A connection between the vein and the artery to create access to the patient’s blood system as well as a good blood flow from the fistula to the machine.

Diffusion A motion of particles in any substance that makes the particles spread evenly in the demarcated space.