The Factors in ICT Development
- Computing Professional's View

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Abstract

What are the factors affecting in ICT (Information and Communication Technology) development? This is not a question to which there is an answer accepted by everyone. IS literature gives different answers where factors vary from technology and organisation to human factors; separately and in interaction.

In this paper this question is answered from computing professionals' perspective. It is based on one computing professional's interview where he describes his vision of the future. The vision is analysed from the point of view of what and who are described as the makers of the technological future. According to interviewee's vision the most important factor in ICT development is technology itself, but several groups of people are mentioned, as well.

This interviewee's vision opens several discussions within IS field. It deals with the shaping of technology and the action space of employees, computing professionals and citizens. Interviewee's vision is useful in opening discussions, but it is limited, as well. The vision is based on technological imperative, and it is a view that gives a limited action space to people.

Keywords: shaping of technology, human actors, action space

BRT Keywords: BD0101, EH0210, Computerization of society, IS professional values

Introduction

I deal with the shaping of technology, and my focus is on the factors that are involved in technology development. In social sciences different views of the shaping of technology have been shown, for example, technological determinism, the social shaping of technology, and actor network theory (see e.g. a review by McLoughlin 1999). I look at the situation from the other side, from the technologists' standpoint. I study the question: How do technologists see the shaping of technology and what is the action space of human beings in it?

Since we are now moving towards to information society where ICT and IS (information systems) have a central role according to generally known definition of information society (Webster 1995), ICT becomes an especially interesting area of technology. When I study how technologists see the shaping of technology, I choose the technologists from this area. These technologists are called computing professionals. This paper focuses on computing professionals' views of who or what makes the technological future.

Existing IS studies (e.g. Markus & Robey 1988, Jones 1991) give some answers on different views of technology development, but they are focused on development in an organisational context, as IS studies typically are (Culnan 1987, Swanson & Ramiller

1993). Whereas I focus on factors which shape the future and the role of people in it. I study them from an empirical basis. I have interviewed 24 computing professionals and asked them to tell me their visions of the future. Although the empirical material consists of visions of the future, I will not make any predictions about the future or evaluations as to whether the future the interviewees described is possible. I am interested in the culture of computing professionals; how the shaping of technology development is understood by these professionals. Although the professionals described their own visions of the future, at the same time they described the norms of the computing field. I interviewed them as representatives of the computing profession, and they described the future in the given context: they were trying to convey the impression that they were competent professionals. So the results describe of the norms the computing field.

The paper is based on one interview. The select interviewee described the factors affecting future making more directly than most interviewees did. He said clearly that technology is the force that determines development. On the other hand, he had several people in his vision, as well. I do not claim that all computing professionals have the similar views of future making, but this vision is useful to open discussion in IS field.

At first in this paper, I describe the research method I have used. This paper is based on one interview, and in second section I present the interviewee and his vision of the future. Third, I describe the discussion interviewee's vision opens. The themes of discussion are technology as the driving force of development, employees' independence, computing professionals' working culture, and citizens' skills. Interviewee's vision is limited, as well, and its limits I show in the fourth section.

The research method

I used a qualitative method and empirical material in this research. This study follows the research process of case study described by Eisenhardt. According to it the following steps are taken: 1. getting started, 2. selecting cases, 3. crafting instruments and protocols, 4. entering the field, 5. analysing data, 6. shaping hypothesis, 7. relating literature, and 8. reaching closure (Eisenhardt 1989). In this section I describe how the most significant phases are reached in this study.

I chose 24 professionals who shape ICT and IS and the ways they are used. Some of them were ICT professionals who make new ICT tools, some of the chosen IS professionals mediated ICT and IS for users, and some were decision makers who designed and defined infrastructure and circumstances for future technology use for users. I interviewed them one by one. The interviews were semi-structured, which means that I defined the topics to be covered, but the specific questions and the interviewing process was shaped during the interview. At the beginning of an interview I showed the interviewee two predictions of future user interfaces and asked him/her to evaluate them. After that introduction to thinking about the future the interviewing topics were changes to 1. technology, 2. the individuals' life, 3. groups or organisations, 4. the (Finnish) society, and 5. the global situation. The interviewing process proceeded from a minor sphere to larger ones.

For this present study I chose one of the interviews and I use it as a case study. This interviewee talked more about the factors shaping the future than most interviewees did. He said clearly that technology is the force that determines development. On the other hand, he has several people in his vision, as well.

I analysed vision of the future the interviewee described to me. From this vision I

collected details which deal with the factors which shapes the future. I found two types of factors: technology and human actors. With human actors I analysed what kind of action space they had in this vision. Doing that I noticed there comes out themes which are dealt with in IS literature and in the present public discussion about information society. I chose the literature that agreed with the interviewee's opinion, and other literature that disagreed with it.

The interviewee and his vision

In this section I describe the select interviewee and the vision of future he told me. At first I locate the interviewee: How is he situated in the computing field? From what point of view does he observe the future? This interviewee is a 27-year-old man. He is a Master of Science in computing science and mathematics. As his hobbies he mentioned sport - snowboarding, surfing, bandy, roller skating, and sailing - natural sciences in general, and food and cooking too. He finished talking about his hobbies by saying:

"But, at the moment, my biggest hobby is work."

Usually I interviewed the professionals in meeting rooms. In this case, the meeting room was reserved for something else, so we talked in the interviewee's office. I wrote about the office in my interviewing diary:

"(The interviewee) had boys' toys, such as a radiocontrolled car, a poster of Donald Duck, Coca Cola bottles."

Due to his education and work experience the interviewee represents the culture of computing field. Additionally, he belongs to the culture of young men. Many employees in the computing field are young men, so, at least partly, these cultures overlap.

Second subject of this section is interviewee's vision: What is the main point of it? What kind of human actors does it deal with? Interviewee's vision describes technological development as an autonomous force, and human actors are shown in the relationships to technology. In the next I show shortly, in my own words, what is the main idea of the vision. In the later sections of this paper I describe the vision using its voice, certainly translated in English.

Interviewee's vision describes technology as a flow that pushes forward without any external aid. Lots of people are standing on the shore of the flow and thinking whether they should step in. Hackers are the first to step into the flow. They go with the flow. They want to go quicker, pass on new waves. On their way trough the flow they try to find out some points that are not generally known, or even not known at all. Another group of people that goes into the flow is computing professionals. Their role is to try to get all other people come along. They build rafts for others, and they advise them. Lots of people go along with it, although some of them try to slow the advance of the flow. People are not going along only because of computing professionals; organisation and national culture push the people, too. Some stay still on the shore. They turn their backs on the flow and do not look at it.

The discussions vision opens

Interviewee's vision is useful in opening several discussions. The vision deals with the

same themes that have been discussed in previous IS studies. Its view of the shaping of technology is that technology is the driving force of development. The other themes interviewee's vision opens deal with people: employees' independence, computing professionals' work culture, and skills all citizens need. In this section I deal with all the themes separately. At the beginning of each passage, I describe what interviewee's vision said about the theme, and then I describe how the same theme is dealt with in IS literature and in current public discussion.

Technology as the driving force of development

In this passage I present what kinds of beliefs about ICT development were discussed in interviewee's vision. The vision outlines the development of new ICT as an independent force. I point out where in this vision it is most concretely shown that the development of ICT is an autonomous force. Then I show some links to IS literature, and at the end of this passage I connect this vision to current public discussion.

I began the describing of the future making in interviewee's vision with electronic commerce. The first quotation tells how electronic commerce was invented. It emphasises technology as the primary factor in this development, whereas people and organisations can only adopt these novelties:

> "Or there is [in the enterprise] a board of directors or a management group which think about these visions. The enterprise isn't helped forward by these visions, but technology provides the opportunities to have such visions. Nowadays technology directs entrepreneurship a **tremendous** lot. No general manager invented electronic commerce. Indeed not. But after an opportunity to electronic commerce has been created, enterprises hesitate, and ponder whether or not they are going to go into electronic commerce."

This quotation reveals the view that technology is the driving force of development. It is expressed most clearly by the words "technology provides the opportunities" and "technology directs". According to this quotation, the only thing people and organisations can do is to decide whether they will use new technology or withdraw from technological development.

I now show another point in interviewee's vision, where the force of technological development and the minor role of people are described. This quotation deals with complicated IS, logistic systems. It suggests that a logistic system may have effects on people and organisation:

> "Logistics are a problem. They can influence ordinary people. Suddenly, all the underground trains leave stations at the same time. The logistics fail a little. These start to influence the individual. In this way they start to influence organisations and society and, in the end, the global level."

According to this quotation, technology has effects on people, organisations, and society, but these effects are noticed just when something goes wrong. In the quotations above technology is shown an independent driving force of development. A similar view is noticed in some IS studies. It is called technological determinism or technological imperative – I use the later one, that is used by Markus and Robey (1988, 585-587). It views technology as an exogenous force, which determines or strongly constrains the behaviour of individuals and organisations. In it people, organisations, and societies adapt themselves to this development. Human beings are stated by their relationship to technology, not as independent actors (Jones 1991). You can find this idea behind the word "user". It underlines the centricity of IS or ICT. The human being, the user, is

defined by the tool. You can see this clearly if you compare the two expressions "a net user" and "a fisherman" (Nurminen 1986, 124).

Markus and Robey (1988) reviewed the different theories about technological development in IS research. Besides of the technological imperative (external forces cause change), they found two alternative beliefs: the organisational imperative (people act purposefully to accomplish intended objectives), and the emergent perspective (change emerges from the interaction of people and events).

Technological imperative can be seen in the Finnish discussion of information society, as well. One example of this discussion is a book by well-known Finnish researcher of future, Mika Mannermaa. In this book, it is clearly stated that technology creation is the most important thing (Mannermaa 1998, 42-43; my translation, the italics are the author's):

> "The primary role of technology in societal development is not a new idea as such. [snip] *It would be intellectual dishonesty to imagine that social phenomena would direct technological development; the relationship is mostly the opposite.* At present, information technology with its several applications is the main field of technology that causes economic, and social changes, and changes in daily life."

Employees' independence

The second discussion interviewee's vision opens, is employees' independence in an organisational context. That theme came out when I analysed how the employees are described in this vision. Employees, and all the human beings, as well, are shown as a force that retards technological development. This is expressed openly in interviewee's vision, but the idea comes out indirectly, as well. The description of users' resistance to new technology deals with retarding technological development:

> "If you have learned something, then, at first, you'll resist any change. Why? You aren't ready to give up the mouse. Unless the new stuff is so easy and the steps between the mouse and the new stuff are so short that you immediately feel you are getting some surplus value. However many times I'll tell you that this is better but it'll take for you a year to learn it, you won't accept it without compulsion, without education."

What do these forms of users' resistance tell us? At first, I represent the view of an IS researcher, Nurminen, on users' resistance, and then I define the differences between the researchers' view and the quotation above.

As the forms of resistance Nurminen gives: the working to rules, working slowed, making mistakes, causing an accident "by accident", and sabotage (Nurminen 1986, 83-84). In the quotation the employee has the possibility to abstain from using a new technological device. This requires a more independent position than the users have in Nurminen's description of the forms of resistance.

Nurminen's book is from 1986, and ICT use has changed since then. Before then, main frame computers and integrated IS were common. Employees depended on the computing staff in their organisation and employees had limited personal freedom of action. At the end of the 1980s, personal computers (PCs) and tool programs (such as word processing and spreadsheet programs) had become common. In some cases the situation really became more personal, but, in any case, the attitude to ICT changed.

Winograd (1995) has forecast a development towards more independent choices. After technology-driven and productivity-driven phases ICT passes on to an appeal-driven phase. In the productivity-driven phase it was important to have economic benefits

and to prove them by cost-benefit-analysis. At the appeal-driven phase the pleasantness of technology becomes the main point. Individuals choose according to their own needs and likings.

Computing professionals' culture

The third discussion interviewee's vision opens is computing professionals' culture. The interviewee is himself a computing professional, so this theme is dealt with more widely than other themes. I shared the subjects that interviewee's vision describes of the culture of computing professionals to two subtitles: homogeneity and masculinity. The two subtitles I found when I look how interviewee's visions told of ICT and IS developing. The vision describes computing professionals as a homogenous group who has similar working habits and they work for organisation best. On the other hand, the vision described some exceptions where professionals used ICT unethical; they used it for creating harm or problems for others. In this case masculinity was marked.

Homogeneity

Although interviewee's vision describes there are needs for alternatives, it states that alternatives are needed for different situations. For example, in the vision the need for alternatives comes up in connection with methods of data input: in different situations different methods are needed:

> "Parallel interfaces are appearing all the time. For different purposes. I don't use the mouse everywhere. Coders don't use the mouse. They just don't have time to raise their hand from the keyboard towards the mouse. They use command lines. They haven't disappeared anywhere. So there must be alternatives."

Interviewee's vision states that there are most cases where prescribed ways must be followed. This can be seen from the quotation above. All programmers - or coders as they are called in this vision - work in the same way; the mouse is not practical for any of them. A convergent working culture is required. If an employee does not accept it, the vision gives the managers of the organisation only one possibility: to give the employee notice to quit:

> "This is just like going back to the salt mines and, by this, I mean that it does not matter what a smart cookie you are, if you can't act in the same way as we do, I must give you the sack. We'll part as friends but, I'm sorry, you can't work with us."

The quotation above describes a demand for convergent ways of action. This fits well with the Finnish public discussion about computing professionals as a homogenous group. In Finland work practices in the computing field were formed in the 1960s and 1970s. The professionals followed consistent practices. It is only since early 1980s some minor variations have been accepted. In other European countries IS development has not been controlled by one set practice, but clearly alternative thinking-models and ways of action were shaped (Vehviläinen 1996). In Scandinavian countries the activity for increasing democracy in working life has affected IS development so that user participation has become considerable (Bjerkens & Bratteteig 1995). The feminist movement is powerful in Denmark, the Netherlands and the Great Britain, and it has given its own emphasis to the development of technology (Vehviläinen 1996).

An informant can choose whether s/he wants to talk about the similarity or the difference, researchers can, too. The sociologist Ylijoki (1998, 170-175) describes the

homogeneity of computing field in her dissertation on academic education. She deals with students' and staff's views on what is a good computing professional. According to them a good professional considers the interest of the enterprise and regards a well-paid job as important. An anthropologist Gregory (1983, 373) studied technical professionals in Silicon Valley, and she showed a variety of views, as well. The professionals had similarities - they all valued novelty and innovations - but they had differences, too, for example, engineers concentrated on developing new products, whereas scientists emphasised developing new technology.

Masculinity

Interviewee's vision shows the masculinity of computing professionals' culture when it deals with misusing - or unethical using - of ICT. At first I show two quotations of interviewee's vision. The first one is such where the actors do not try to get some benefits for themselves. They are hackers for whom the breaking of data security is only a game. The following quotation deals with such situation:

> "These are maters of data security. Systems have been hacked. Your picture of the world changes very quickly when we, boys, visit in your systems. And we are still nice. Someone does that in real earnest. In practice Internet could be exploded."

In the second quotation the aim of the misusers is to obtain benefits for themselves on principal. It is a criminal act. The end of the quotation above refers to such a situation, and interviewee's vision continues:

> "I'm quite sure that at the next stage information systems will explode. Hacking is what people are afraid of. It'll be a horrifying picture. A digital cold war. Maybe at that stage there will be spies, or they'll work in an intelligence service. They won't have to touch James Bond's bravura, guys will just drudge at the computer."

The misuse of technology brings out the masculinity of computing field. Hackers and spies are usually thought to be men, and in public discussion they are normally shown as men. The quotation above, too, deals with men; for example, there are expressions "we boys" and "James Bond". A study of Norwegian hacker culture shows the interrelationship between maleness and computing (Håpnes & Sørensen 1995). Hacker culture is an extreme example of computing field where male culture dominates. Maleness is seen in several studies; I give some examples of them in the following. Camp (1997) reports the problem of the pipeline shrinking and discrimination against woman in computing culture with using statistics. Vehviläinen (1996) describes how men determined the working style in the computing field.

The skills of citizens

The fourth discussion interviewee's vision opens is the skills all citizens need. The vision deals with ICT use in leisure time and by citizens, as I call it. In this section I show how interviewee's vision describes ICT use by citizens and how this theme is dealt with in current public discussion.

In interviewee's vision ICT using skills are compared to the ability to read, and they are called the ability to read media. So they are highly valued. It is said in the vision:

> "At school in the 40s we were taught to swim. The ability to swim was important. Or the ability to read, in all history this has been the thing that determines civilisation, development. We have taken care of it particularly well. And there is the ability to read the

media. The way people see this information space. It's a skill, a skill that can be learned, isn't it? Some are naturally more talented than others. But in principle all the citizens of a country must be raised at least to a certain level, it's the same thing as with the ability to read."

This view corresponds to the current public discussion in Finland. The aim is to give to all pupils basic skills for using ICT and, for this purpose, all schools will be supplied with computers before the year 2000. Similar hopes are expressed in other countries, as well. Bill Clinton, for example, stated his hope as to what kinds of skills American pupils should reach (from Harrison 1997, p. 32):

"Let's work together to meet these goals: Every 8-year-old must be able to read; every 12-year-old must be able to log onto the Internet; every 18-year-old must be able to go to college, and every adult American must be able to keep on learning."

Harrison says that Clinton's speech follows the current rhetoric. He himself, as a teacher, assumes a critical attitude towards the use of new technology in schools, since he finds other things more important to learn and for learning (Harrison 1997).

The next quotation continues the speech of citizens' technological skills as they are described in interviewee's vision. The quotation compares Finnish people's skills to the skills of the citizens of other countries:

"It would be cool, if we could raise higher than our neighbours in a global comparison of knowledge, or using of tools, or specific skills. It would be hot stuff globally."

The quotation above follows the public discussion about information society in Finland. In it, technology is usually seen as the main focus, and it is often presented by statistics that show the diffusion of technology. For example, a larger fraction of Finns have mobile phones (50 %) than in any other country (Lyytinen 1999). The quotation above does not refer to technological infrastructure but the use of technology. Also, according to statistics, Finns have reached a high level in the use of technology: Ten percent of Finns use the Internet every week to pay bills or to buy services (Lyytinen 1999).

Interviewee's vision includes people who do not use ICT at all; they avoid it in their work and in their leisure time. These people fall behind in the flow of development. In the following quotation this situation is shown. It is done by using antitheses; two groups of men are compared. One group consists of young men who are interested in ICT, whereas the other group consists of older men who avoid ICT. In the quotation the use of computers is connected with having social contacts. The people who use ICT are described as people who meet people face-to-face and on the other hand, the people who do not use ICT are seen as passive in all social contacts. According to the quotation people have social contacts in both virtual and real worlds, and these two worlds support each other. This is what is said in interviewee's vision:

"So, all these nerds who use the machine, every single one, yes. The keenest nerds have such a strong subculture that they'll, fucking, beat six-nil their parents in it. [snip] Guys, these teenagers, travel to Norway by any ways they can and live there in a big hall with millions of computers. It's cool. Whenever a new subculture is born, it creates a hectic life. And then there is this middle-aged Bold and Beautiful - generation. They are in a cleft stick. They just receive, from television, for example. They go to work, and they do not speak with anybody. They go home, beat their wives, drink spirits, and watch the Bold and the Beautiful."

This quotation shows the use of computers as a positive thing. Such an attitude is seen in some other studies, too. Sproull and Kiesler (1996), for example, describe the good

effects of e-mail in organisational communication. According to them the use of e-mail enables people who are peripheral in organisations to become more visible, although computer aided communication does not always go as good as expected, not all problems arise from the tool itself but from the ways in which it is used (Markus 1996). These are the structures of the society behind the problems. You can see them in the faceless communication trough net, as well. For example, gender differences are seen in the ways people discuss in the net (Herring 1996).

Limits of interviewee's vision

Interviewee's vision is useful since it opens discussions in IS field, but the vision is also limited. In this section I deal with the limits of interviewee's vision. It is limited within its view of the shaping of technology, that is technological imperative. IS literature describes alternative ways, as well, and in this section I describe them.

Interviewee's vision describes that technology is the driving force of development and human beings' role is just adopting technological novelties. Markus and Robey (1988) has called this view as technological imperative. In their review of the different theories about technology development in IS studies they found two alternatives to technological imperative. They are organisational imperative and the emergent perspective.

The organisational imperative assumes almost unlimited choice over technological options and almost unlimited control over the consequences. The role of systems designers (or computing professionals) is central to the organisational imperative; it is believed that they can manage the impacts of information systems by attending to both technical and social concerns. Empirical support for the organisational imperative is limited (Markus & Robey 1988, 587-588).

The third view is the emergent perspective. According to this view the uses and consequences of IT emerge unpredictably from complex social interactions. Predictions in the emergent perspective require detailed understanding of dynamic organisational processes in addition to knowledge about the intentions of actors and the features of ICT (Markus & Robey 1988, 588-589). Present social science names this view, or at least a quite similar view, as actor network theory (McLoughlin 1999).

An example of the shaping of technology in complex social interaction is Orlikowski and Robey's (1991) study. It shows the interaction between technology, people, and organisational properties. There are two kinds of human actors: computing professionals who have an influence on technology, and users who are influenced by technology. Allen (1998) says that for computing professionals the conventional way to shape the future is through public activism and commercial practice - that means making decisions in projects within an organisation. In addition to political activism and professional ethics, computing professionals can shape the future by helping to define new computing technologies and the direction in which they should go. Allen claims that the future of technology is made by problem framing, that is the basic assumptions about what problems a new technology is trying to solve.

Orlikowski and Gash (1994) describe users' role in the shaping of technology. They studied how the technological frame - interpretations of technology - influences the use of technology. When users have a technological frame different from systems designers, users may use the system in a way different from that which the designers have planned. Designers are actors in the shaping of technology, and so are users, in those

cases where the technology is flexible; they shape technology through the ways they use it.

Above I described the ways what possibilities human beings have in the shaping of technology. In any cases the human beings' action space is limited. Iivari (1991) shows some limits: he criticises the view of technological development as a matter of human choice as too simple, since the decisions made previously limit nowadays freedom of action. For example, nowadays no one can decide that an organisation will give computers up. Vehviläinen (1996) deals with different kind of historical decisions that have effects on nowadays freedom of action. She states that the work of computing professionals is managed by the culture of computing field, and it has shaped by the way the work has been carried out. Decisions made in the past and in everyday work practices have effects on what technology will be like in the future.

Conclusion

In this paper I described computing professionals' views of the shaping of technology and people's action space within it. This paper was based on one interview, but several IS studies was connected to interviewee's view.

Interviewee's vision is useful since it opens several discussions. I dealt with discussions in the following themes: technology as the driving force of development, employees' independence in organisational context, computing professionals' culture, and skills all citizens need. In interviewee's vision technology was shown as the driving force of development and information society. The same view is found in some IS studies and can be found in the present public discussion of information society. Interviewee's vision showed employees' roles in organisation more independent than older IS literature does. In the vision employees made choices of using technological tools by themselves. On the other hand, computing professionals' freedom of action is limited: In interviewee's vision the culture of computing professionals is dominated by requirements of homogeneity and masculinity. To all citizens interviewee's vision included a hope that they all had skills, and desires, for using ICT.

Interviewee's vision opened discussion, but it was limited, as well. The limits of interviewee's vision were connected to its view of the shaping of technology. Since the vision was based on technological imperative, people's action space was more limited than in those IS studies that were based different view of the shaping of technology.

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