Scandinavian Journal of Information Systems

Volume 29, No. 1

Publication date: 30 June 2017

eISSN 1901-0990

Work Informatics—Mon Amour

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Abstract. This article displays the professional career of the author. It is started with a chronological narrative of his academic work highlighting some crucial events in it. The main contribution of his work is a conceptual framework called 'Work Informatics' that regards the use of information technology as an inherent part of the work of the actual user. This framework is briefly explained. The final discussion tries to transcend the restrictions created by the unusual subjective character of this paper: what are the lessons learned and how are the two stories connected?

Key words: Information system, work, actor, social interpretation, organisational implementation.

1 Introduction

Shortly after retiring in 2009 I started to think whether I had accomplished anything during my academic years in research. I picked up the list of my publications. I must say I was quite disappointed with the image it gave others about my career, but not in terms of quantity or quality. The beef of my work was not noted on the list; somehow it emphasised the wrong aspects. Then I extracted a few more essential aspects that could be called theories or frameworks that I had created or that I had contributed to their invention. This list clearly gave a better answer to my original question. These were something I really had done. This list thus became the beginning of these memoirs and the frameworks summarised below. The first part of this paper tells the story that needs to be told to connect the items together. The second part tells more about Work Informatics (WI), that is, the most comprehensive framework to which I have contributed. Finally I conclude with some remarks on the period that has followed my working life.

I am rather confused about speaking about my life in the first person. Yet I never had an academic life that was distinct from my personal life. My research has always been part of my

Accepting editors: Arto Lanamäki, Rudy Hirschheim and Jaana Porra

social and political activities. Therefore, I believe this offered personal context will bring the true taste of my life to these academic contributions.

2 Year by year

I received my student grade simultaneously with my sister, two years older than me. For most of my school years, all my classmates were two or more years older than I was. Yet I survived those teenage years by using two tricks: First, try to avoid open confrontation because you will be the loser; and secondly, learn to create alternative interpretations of all situations that may develop into conflicts. In my case, it became clear that I have been repeating these cornerstones of *Finnlandisierung*[1] throughout my whole life and in particular during my research. Not even research can be explained in terms of the object of the work alone, as the researcher makes the result. In the special issue of careers, however, it is legitimate to refer to personal background of the kind spoken of here.

2.1 The path to computers and research

I started my university studies in Mathematics at the University of Turku, Finland, in 1960, to achieve a professional competence for a related and appropriate job. Just a few months before receiving my Bachelor's degree in 1963 I went to test for programming courses organised by IBM. After a successful test, I participated privately in a course that opened access to a summer job at IBM for a few subsequent summers. My programming skills also opened the doors to employment at the university to initiate the very first programming courses there, which was more an opportunity to earn money than my major vocation.

My Master's Thesis was on Operation Analysis wherein I contributed to a particular search problem. I was happy and motivated because I learned that when a small child gets lost in a forest, good search methods are invaluable. It is what I was told at the start, but only later did I understand that the object of a search could become an unfriendly submarine as well.

Life in Turku in the 1960's was not isolated from international cultural trends. Woodstock and other hippie movements also declared, "Make peace, not war!" This atmosphere stimulated us in our small research group to design experiments using computer music, also used for small breaks from military applications. I was playing clarinet in the students' wind orchestra, and I also conducted this band for a few years. This hobby led me to study more musical theory. In 1966, I received a Master's degree, and during the next year, I published my first composition: A Finnish tango, created using a multi-level Markovian process run in the University's then only computer (Nurminen 1971)[2]. It was my first and hopefully last contribution to Artificial Intelligence. The model turned out to be successful in finding small melodic fragments, but it was quite poor at mastering larger musical structures. The composition did receive, however, reasonable publicity. During the composition period, many other researchers produced compositions using computers. This tango project was original, however, in attempting to compose pieces within an existing genre of popular music. For me, the project was a failure because I had

to finish the composition manually. However, it was the starting point of my passion to get rid of using computers as a subject; as an actor on its own.

When I returned from my military service in 1969, I had to decide whether I should or should not continue my research activity. My licentiate thesis (the intermediate level between MSc and the PhD) before military service continued the optimisation genre within search problems. At the time of my return to civil society I was lucky, because the then Humanities faculty was inviting applications for the position of mathematician within various areas of the Humanities. Thus, during the next two years, I had the privilege of creating an archive of spoken dialects over all areas of Finland (Professor Osmo Ikola) (Nurminen and Karjalainen 1972). Another big project was the morphology of the Finnish language: A generation of a computerised set of rules for verb and noun conjugation (Professor Kalevi Wiik) (Wiik 1967).

Wiik was also working on Chomskian generative grammars, which were useful in parsing both natural and programming languages. My programming skills were challenged in the coding (using machine language!) of the driver for the speech synthesiser 'Ove'. Many other smaller projects were part of my adventure into humanistic research. Probably the most important lesson I learned was that whereas social sciences focused on collectives of people, in the Humanities, the single individual was a central and legitimate object of study. It is allowed to study a single book written by a single author without having to collect a representative sample of books and authors. Little could I see then the potential accumulating of competence around computers and the humanities that was later to significantly direct my research work and career.

2.2 Moving toward the Ph.D.

My life with the Humanities was a dream, exactly like a child who is happy in a candy shop. It had one obvious disadvantage, however; the work was unfocused, so I had to jump from one project to another. I could not formulate a personal research trajectory for myself, so my knowledge was not cumulating towards anything that could become a PhD Dissertation. Then, in 1971, I decided to apply for a position as a lecturer, later an assistant professor, in information systems at the Turku School of Economics (TSE).

At the same time, the Scandinavian School of Information Systems was taking its first baby steps. Börje Langefors had published the seminal monograph (Langefors 1970) *Theoretical Analysis of Information Systems*, THAIS, in two volumes in 1970. Along with his core group, he organised some very popular summer courses located in and including participants from all Scandinavian countries and Finland. I attended one of them in summer 1972 in Oppdal, Norway.

This was a starting step to my own development as IS researcher. I started to write small articles and publish them mainly in the publication series of the Turku School of Economics (TSE). Soon I had contributions that seemed to offer a basis of a PhD thesis. Yet it turned out that many of my colleagues at the TSE treated me as an outsider who was not properly initiated into the spirit of a management school. Instead of support, I experienced the sense that they were not very eager to let me present my thesis at the TSE. Then I went back to the university, where Professor Timo Järvi (Computer Science) welcomed me. There I presented my thesis in autumn of 1976 at the University of Turku and received a grade from a genuine philosophy (rather than a business) faculty. As an extra credit I even had a rare minor grade in the discipline philosophy.

As a conceptual framework, I had adopted the theory of fuzzy sets, probably because the idea was quite popular during that time. Still, and perhaps more significant for my future work, was the reformulation of the *Infological Equation* (Dahlbom 1995) introduced by Börje Langefors. In his formulation the infological meaning of a message was constituted not only of the data, but also the time and place of the presentation. I wanted to add the purpose of information to this list. I illustrated my claim using the example of *the monetary value of the company's storage*. That information may be requested by the financing manager, the insurance investigator, or the tax authority, each with different interests and goals. It is obvious, therefore, that the numerical value will be different in each case. This was the first step toward my later interpretation of information and its processing as inherent parts of purposeful human activity.

The opponent of this dissertation was Professor Pertti Järvinen from the University of Tampere. This contact was maintained, when I started to use the monographs written by Järvinen and Pentti Kerola (University of Oulu): Systemointi I and II in my teaching (Järvinen and Kerola 1975). Thus, I was not at all surprised when I received an invitation to Tampere for a summer seminar in 1978 that is better known now as the first meeting of the IRIS tradition. Even though the initiative came from Pertti and Pentti, I was the most active participant at these meetings over their first three decades by attending all of the first thirty seminars. For me, it was at the time an excellent forum to present my work in its early phase and receive solid feedback.

IS research in Scandinavian countries was then divided into two fractions, namely, the Langefors group (THAIS) and the work-oriented action research done together with the local and later even with the national trade unions. The latter fraction soon became an iconic representative of Scandinavian IS research, whereas the Langefors approach led to several early formulations of IS development methodologies, quite similar to the later popular structural analysis and design methods. Probably the best known of these was the ISAC methodology.

There was a certain tension between the two directions, because the trade union wing interpreted the THAIS researchers as being committed to the owners' interests, not to the workers. Interestingly, the IRIS meetings fostered both wings with only with minor friction. At several of the meetings of the Boards of the IRIS Association and the Scandinavian Journal of IS, we had debates about the orthodox interpretation of the Scandinavian School. Some members wanted a more restrictive policy; only the radical (often in terms of political meaning) enough approaches could qualify as truly Scandinavian. Each time a liberal view was selected (Iivari and Lyytinen 1998). For me, this choice was fine, because I hoped to receive tolerance of my sometimes-dissident approaches in an atmosphere that I could sense was not too exclusive. The Scandinavian School of Information Systems is probably impossible to define; it probably defines itself through its practice in the spirit of *Wittgenstein*. The openness described above made it also free to foster creative exploration of approaches that did not subscribe to many of the mainstream movements.

Meanwhile (1978) the Turku School of Economics had established the position of associate professor in Information Systems. Of course, I applied because I thought that in that role I could better contribute to the School and the discipline. I must say I was very disappointed when the School decided to nominate one candidate who came from another discipline, Management Science. I had problems both in terms of trust and the motivation for collaboration, and I was happy when I received an office room in a small distant building. This destiny gave me an opportunity to enjoy daily coffee breaks spent with a small group of sociologists. These

discussions gave me broad and in some respects also deep insights into people problems; i.e.; sociological thinking.

These new circumstances did not end my research activity. I was one of the organisers of the IRIS 2 in 1979 in Dragsfjärd. In IRIS 4 (Oulu), I presented a paper with the title entitled "Against System; A Human Perspective on Information Processing" (Nurminen 1981). It illustrated the strictly questioning character of a young researcher with a strong self-confidence who questioned a predefined commitment to the development of an information system, typically with an integrated architecture. One could also anticipate the early formulation of Work Informatics in this title.

My commitment to the work environment at the TSE was, however, low. I kept my eyes open for promising opportunities. That trigger came from a surprising direction: the University of Bergen (Norway) had a department that was shared by two faculties, the Social Sciences and the Humanities. They had two full professorships, one for each faculty orientation. I decided to apply for the Humanist chair although I must confess that I did not seriously expect to receive the position. However, the evaluators (Börje Langefors and Sture Allén) gave strong weight to my experience with the humanistic applications I had undertaken earlier. In January of 1982, I thus travelled to the west coast of Norway and started to teach and also figure out what humanistic research in information systems could be. My earlier summer job in Stockholm as a teenager turned out to have been a good investment, because I had learned then to use the Swedish language in actual practice. I could start at Bergen as a 'competent Scandinavian'.

2.3 Humanistic research

The Department of Information Sciences at the University of Bergen was quite exceptional. Two faculties with a spelled-out focus on human beings wanted to utilise and promote information technology. The origin of this policy may be found in the growing interest (especially in social sciences) in factor analysis and other multivariate analysis methods that were eagerly welcoming the calculation capacity offered by computers. This view was, however, very close to the situation that I already had faced in my time as the mathematician for the Humanities. My clients then regarded computers as tools for solving research problems formulated by other disciplines. I wanted something more from my work. I wanted to make the phenomenon of information processing itself to the main objective of this research.

I formulated my first version during my first term, Spring 1982, in the course entitled "Human-scale Information Systems" (HIS). That version was 'published' in the form of local lecture notes. In the document, the new system architecture offered by HIS was analysed from multiple perspectives, among others, the ontological, epistemological, cognitive, behavioural, organisational, sociological, and technical. HIS is a conceptual construct of system architecture that is decentralised to consist of subsystems that are used by one individual employee. Such system units have a set of locally stored files and application software. This design integrates the IT tasks to an inherent part of the work tasks of the related actors. In addition, the structure divides the responsibility for IS deployment to the respective actors. Communication between these very personal systems is naturally interpreted as organisational coordination.

In the HIS construct, my concept of a human being takes its first steps towards the work role in Work Informatics. This notion builds on the person as the active subject of her life and work and is open to responsibility and competence. For example, her work is not regarded only from the outside as in many business processes, but also from the inside; values, knowledge, commitment, and understanding are relevant factors, as well as the will. The will is not completely free, however; it is restricted by physical (she can swim but not fly) and social (do not kill people, but keep your promises) constraints.

One more contribution to the Bergen department was an organisation of the IRIS 6 seminar (1983 in Øystese, close to Bergen) with the student group from Bergen. This task can be seen in the context of the mission to make the originally Finnish idea about IRIS truly shared among all Scandinavian countries. The four first meetings took place in Finland. IRIS 5 took place in Stockholm, where Kalle Lyytinen happened to reside as a guest researcher. The next logical step of this Trojan horse trick had to be Nurminen in Bergen. After this step, Helsinki could take its turn again (1984, Markku Sääksjärvi). Then it was easy for Lars Mathiassen to invite IRIS 8 to Aarhus as an appendix to the second decennial Aarhus conference in 1985.

During my Bergen years, I never really lived in this city. I worked two weeks in Bergen and then spent one week at home in Finland. The Scandinavian Airline System (SAS) helped me organise my travelling, so I could pay a visit to many places close to my landing airports on my way to or from Bergen. I could visit Oslo, Stockholm, Gothenburg, Lund, Copenhagen, and Aarhus. I remember these visits for their stimulating discussions with and the good contacts I made with many Scandinavian researchers. I still am thankful to all who were involved.

This surfing across Scandinavian universities later led to many contacts. For example, I was invited to act as the opponent in multiple PhD dissertations. I choose to pick up just a few of these, and they became the most significant experiences for my own development: Göran Goldkuhl (1980), Kalle Lyytinen (1986), Pelle Ehn (1988), Kari Kuutti (1994), and Susanne Bødker (Dr. scient. 1998). All five have had remarkable successes in their own research careers. I am convinced that this success is not simply from the merit of having me as their PhD opponent; rather I am happy for the opportunity to have learned of their early achievements.

Once again, accidental, almost arbitrary, conditions outside the academic work itself turned out to have an effect on my career, this time my commuting. Today the international nomadic life is more likely to belong to the planned life cycle of research education. It opened the challenge for me to explain my thinking to new people with different backgrounds. As an extra bonus I found both friends and a professional contact network.

2.4 Farewell to Bergen

The experiences from my years in Bergen started to take the form of a framework made up of three perspectives to information systems with the title, *People or Computers* (Nurminen 1988). It was published 1986 in Finnish (WSOY) and in 1988 in English (Studentlitteratur), even if most of the material was already presented in the department in Bergen before I had to return back to Finland in 1984. This move happened partly because my family would not move to Norway and partly because I was unable to convince the faculty about my intention to turn the development and use of IT into the object of research from a humanistic perspective (Nurminen

and Rønning 1984). In the monograph, two alternative perspectives accompany the humanistic perspective.

The framework of three perspectives for seeing information systems was directly derived from the HIS approach. These three perspectives were systems-theoretical, socio-technical, and humanistic. The humanistic perspective was fully consistent with the HIS architecture. The two other perspectives were needed as scaffoldings for the humanistic perspective; it had turned out that not even all my co-workers in Bergen were able to understand the HIS concept and see the role of paradigms in research. The revolutionary ideas concerning paradigms by Kuhn (1962) started to have an influence in various disciplines during the 1980's, at least in the Scandinavian countries.

The strength of the three parallel perspectives was their ability to give different interpretations to one existing phenomenon, an IS in actual use. These perspectives were characterised by ideal types, and differences in the notions of knowledge, a human being, and organisation were identified.

The three perspectives were constructed based on the relationship between the computer and the human being. In the systems theoretical perspective the main focus was the computer and the people needed to operate (serve) the computers. The humanistic perspective was the opposite of this viewpoint. The human being was at the core, and the computer was seen as simply a means to realise human needs. The intermediate perspective, the socio-technical one, aimed at finding a balance between these two extremes. Boström and Heinen (Bostrom and Heinen 1977a; 1977b) had introduced the main principles of socio-technical design applied to ISD, and Enid Mumford was successful in giving these ideas a more concrete methodology called ETHICS (Mumford 1986). A balance was created by the acknowledgement of two parallel systems, the social and the technical. These systems were designed in separate tracks, and the most promising parts of both were finally connected to create a joint optimal solution to the original problem. It was a revolutionary setting, because most of the earlier approaches to the design of the social system had been based on the machine metaphor of organisation. According to this idea, organisations had been designed according to the same mechanistic principles as machines on a shop floor. The idea of two distinct systems argued that social systems are fundamentally different from technical systems, and therefore, they deserve to be designed using their own principles and methodologies.

This invention had a huge impact on our discipline, as the practices of research and development of information systems became richer and certainly achieved improved quality in many ways. Yet at the same time, however, a socio-technical trap emerged as an unintended consequence. The setting of two parallel systems implied that they were different, sometimes even distinctively so, from each other. The technical system thereby received an autonomy that made it independent of the social system. The technical imperative seemed to be to generate neutral and unquestionable objectives. In my mind, behind these objectives were the interests of human beings, and they were fundamentally social. The social origin of technically designed information systems has still too often, therefore, disappeared from sight, and interpreted in terms of Berger and Luckman (1966), so they were reified, which means inhumane. Most of my thinking is based on the idea that all technical systems are essentially social systems and (therefore, hopefully) controlled by their users. This *Credo* implies for me that IS research has always been a part of my own social and political activity.

There is an interesting overlapping in the titles of the three perspectives and the three traditions presented by Jørgen Bansler (1987 and 1989). Two titles have a full coincidence: Systems theoretical and Socio-technical. Bansler's third class bears the name 'Critical Tradition', whereas Nurminen's third perspective is considered 'Humanistic'. This difference indicates that Nurminen does not, along with the humanistic perspective, subscribe to the critical political agenda embedded in the critical tradition. The humanistic perspective aims at improving the actors' understanding of their work situation both broadly and deeply. Then the actors are free to enter and become better equipped in the negotiations of their future work situation when any unintended consequences also become visible. I am fully aware that this stance includes a flavour of Hume's guillotine, but if we do not keep different domains of activity apart from each other, we may find ourselves searching for partners to new coalitions; e.g; political parties, immigrants or sexual minorities.

I was lucky to receive the position of associate professor at the University of Turku in 1983. I started to document my Norwegian experiences in the monograph. In parallel terms, I wanted to initiate empirical research into the three perspectives, in particular the Humanistic Perspective. This circumstance created a dilemma. It was impossible to find such applications to study that were designed according to humanistic perspectives simply because none of them existed. Our research team had to find out how to undertake empirical research about an object that did not exist. The following strategy was thus outlined:

First study the use situation of an information system already in use. Collect information about that use situation paying special attention to the work tasks of the users, both in individual and collective settings. Then analyse the structure and functioning of the system in detail. Problem situations and breakdowns are interesting, because they make the work aspects of the IS visible. Using all this information about the current use of the IS, translate the description into the HIS format by de-integrating the data bases into personal system units and dividing the system functions so they constitute a part of the division of labour between the employees. This reconstruction is called the social interpretation of the IS and the work situation, and it was generated to be used as a reference in a comparison with the original situation. The Academy of Finland approved a grant to our research group for the project "Knowledge and Work" for three years 1986-1990.

The value of IS research is ultimately demonstrated in the practical use of information technology. Therefore, our research group wanted to go to actual users. It happened that we were invited to a dozen companies and other organisations to help in their deployment of existing information systems. Most of these cases were contracted research; i.e.; the customer paid our contract in full. Our niche was known as *Social Interpretation* and was a variation of the Humanistic Perspective. It was created by reducing computer functions to the actions of the users, often by imagining the corresponding tasks that had to be done without computers. Such an alternative interpretation makes the work and its coordination visible in a manner that is independent of the current computer-based solution. It can be used as a benchmark for evaluating the benefit of the current system, namely, to what extent does the system contribute to the objectives of the organisation?

Most customers were satisfied. We found really dramatic problems in actual use situations, however, more often than once, we had to make an intervention to successfully rescue the responsible information manager. The top managers intended to fire him/her because s/he had

allowed these big scandals to happen. We told them that similar scandals occur in practically all organisations, so it was nothing extraordinary. The direct financing by the companies could also be seen as a proof of the relevance of our approaches. All users at different organisational levels were happily enlightened in their understanding the new interpretation. No direct confrontation between the different groups emerged during our interventions, perhaps because both workers and their managers wanted to do their work well and professionally. Since this goal was their primary interest, the other contradictions potentially surfaced later. The integrated structure over user groups at multiple levels of the organisation was described using an ONION model; it included a description of the activity and its objectives at each level, accompanied by an evaluative view of the related parts of that IS.

2.5 The Jyväskylä intermezzo

At the end of the 1980's, I sent an application for the position of full professor to the University of Jyväskylä. The IS department by then had grown to a significant centre of research and teaching in Information Systems, thanks much to Kalle Lyytinen. The nomination was rapid and dramatic: I made a complaint on the selection procedure, it was accepted, and suddenly I was nominated (1989) and lost my previous position in Turku.

The time was economically critical in Finland. It was practically impossible to sell our house to finance the family's move to Jyväskylä, so I had to start commuting again. My co-workers elected me to be the head of the Jyväskylä department, and there I learned a lot about university administration. The weekly travelling of four hours on the train was just enough time to read and comment on one manuscript submitted for a Master's thesis. Again, I was able to benefit from my travelling, as Tampere was in the middle of the journey between Turku and Jyväskylä. Almost every week I stepped off the train to have a meeting in the cafeteria of the railway station in Tampere with Pertti Järvinen. We organised a conference on behalf of IFIP WG9.1 (Computers and Work). I held the program chair whereas Pertti was the real organiser. The conference entitled "Human Jobs and Computer Interfaces" took place in Tampere in 1991. Of course I certainly was worn out after two years 1990-92, but I was happy when I had the opportunity to get back my old position again in Turku.

In Scandinavia, contacts in the informal tradition of reoccurring seminars started to became more institutionalised. In the 1988 IRIS9 meeting in Røros the *Scandinavian Journal* was established, and soon the IRIS Association received its first bylaws and Board. Both steps gave IRIS community continuity and identity. I had the privilege to be a part of both of these emerging traditions.

In Turku we established an organisational unit within the University of Turku, called Laboris (labor=work, is=information system) to produce research with a focus on the relationship between work and IT, in order to have a credible counterpart when negotiating with our customers. Later we established a full-blooded commercial company. I was a stakeholder (minority owner and Board member) of that company; Ulf Forsman was the CEO). The activities of the firm were successful, and after three years we received an offer given from a great company that gave us owners multiple compensation for our investment.

In most of our customer contracts, we did something that could be called organisational implementation. Indeed, we often were faced with a situation where the customer organisation had neglected the organisational implementation and made only technical implementation. We had to help them compensate for that failure afterwards.

2.6 Organisational implementation

Organisational implementation is based on the notion of the inseparability of IT from work in a use situation. This notion is a consequence of the transcendence of the socio-technical trap and also one of the cornerstones of the Work Informatics (see next item). Organisational implementation emphasises the need to make changes to all aspects of work and its organisation; technical installation alone is not enough. The broad range of this change is well illustrated by the example of user education for a new electronic patient record (EPR) system in the city of Turku. There were about 600 future users, 60% of which never had used any computer-based information system before at work. The system supplier had installed a learning environment where the users could safely experiment with various aspects of the system. The first session was organised by the supplier and one of their software experts introduced the system and its functions. People were dissatisfied and refused to continue the collaboration with a person whom they believe had no insight into their own professional practices.

Dramatic changes were made. A team of experienced nurses was recruited to redesign the entire education project. Lots of new material was produced. The teaching event was organised as a sequence of episodes of work activities relevant to the group in the learning environment. Each episode consisted of two parts: 1) this is how we used to perform these work tasks earlier, and 2) this is how we shall do the same tasks in the future. In Phase 2, the new practices with the new system were demonstrated and displayed on a big screen; the participants were then encouraged to experiment with the procedures on their workstations. To sum up, the basic unit of new learning was not a set of operations (Leontjew 1978) but rather an entire chain of actions that were loaded using the spirit of activity (good work practice) of health care. This new emphasis is well illustrated by the Irmeli Sinkkonen aphorism[3]: "The work of the users is not to use the system!"

3 Work informatics

Work Informatics is a theoretical framework. While it addresses many of the problems of Informatics (Information Systems Research), it also takes a special perspective that differs from the main stream. Information technology (IT) is part and parcel of any branch of informatics by definition, but work informatics regards IT from the particular angle of focus of the work. Traditionally, work has been located in the context of the focus called information systems. Work informatics swaps the focus and context. Work is in focus, and information technology is but one part of it (or even part of the context) and thus receives only secondary attention. This aspect is because the ultimate criteria for the success or failure of an information system are outside

the system itself and only in the activities it is supposed to support. This claim is obvious when you consider the timeline of the accumulating costs: Analysis, design, and implementation carry most of the costs, whereas benefits can be collected only during its use in work organisations (Nurminen et al. 1987). The conceptual framework of Work Informatics is also inspired by the experiences of numerous (1-2 dozens) case studies performed by Laboris. A reversed emphasis in the point of departure requires a comprehensive understanding of work and its organisation; e.g; through making a distinction between the three modalities of work.

Another point of departure is the untraditional positioning of the IT in work organisations. Computer software is interpreted as an inherent part of the work tasks of the actual user. This interpretation embeds the instructions of the computer program as specific steps for the user's work process. This choice assigns a human actor to the computer functions. The image of the computer as an actor on its own is unnecessary. Work informatics has little use for the formulations of Artificial Intelligence or expert systems. On the other hand, there is no need to argue that research made within the domain of artificial intelligence or Actor-Network Theory (ANT) is wrong or even useless. Work informatics intends to demonstrate that meaningful and significant research can be done even without the assumption of a machine subject.

One important consequence of these two premises is that they also position work informatics in the on-going debate between technical and social. Work informatics is strongly in favour of social dominance. If the execution of a computer program is work performed by a human actor, then there is not much left to be explained in terms of its purely technical aspects. Even the decision to introduce information technology is made by human beings with human interests. This makes most socio-technically oriented approaches less interesting, in particular when they are articulated in terms of two parallel systems; i.e.; the social and the technical. Such a setting implies the risk that the technical system is granted independent status with its own, non-social, requirements. This risk was earlier named the socio-technical trap.

Since we have selected work as the cornerstone of work informatics, we need to explain what we include in this concept. For the time being, it is enough to open the concept of work as being purposeful human activity performed alone or in a work organisation. It can be either paid or unpaid. One can do it as an employee or as an entrepreneur. Work can be full- time or part- time, permanent or temporary. The different virtual work practices distributed over time and place are not excluded from our analysis. We challenge our conceptualisations by applying them; e.g; to the emerging forms of a platform economy.

The first premise of work as the primary substance is that we must first make it more operational. Only then can we[4] outline how computer functions can be embedded in the work of actors. First, we will introduce the three modalities of work:

Working individually. We all know that work is socially determined; there are not many Robinson Crusoe jobs that can be done in total isolation. No group or other collective can accomplish its tasks unless its individual members do their articulated share of the joint effort. Individual actors simply cannot be ignored.

Working collectively. Work organisations are necessary to perform more extensive efforts that one actor is able to do for quantitative (heavy) or qualitative (skill and knowledge) reasons. Collective work is thus in a dialectical relationship with individual work: neither can be thoroughly understood without a clear reference to the other.

Service work. There are two parties, the customer and the producer, in service activity; the parties thus exist in an asymmetrical relationship. Service differs from collective work, since the parties are positioned on the opposite sides of the transaction counter, whereas the members of collective work are on the same side of that counter. Service providers aim at producing added value to benefit the customer and her processes. The customer, on the other hand, outsources some parts of her processes to be handled by the provider.

3.1 Individual work

As indicated above, each instruction in the computer program is interpreted as a step in the user's work process. This work-centred interpretation has far-reaching consequences. First, it liberates us from the burden of defining the computer (or information system) as an actor: What are the similarities with and differences from human actors? Confusion about the computer agency as reported by e.g. Weizenbaum (1972) and Turkle (1984) can be easily clarified by identifying the true human actor. Secondly, the tasks performed by the information technology constitute an inseparable part of the work of this actor. There is no separate IT sphere that might give rise to the user's experience of IT as an extra burden that does not belong to the work proper. In Work Informatics, intentionality is the key characteristic of work, and it enters to computerise tasks through the intentions of the user. The dominant approach for addressing such intentional and purposeful activities is the use of Business Processes.

We have selected the business processes (Hammer and Champy 1993) as the first candidate for representation of human work because the instructions of computer programs belong to the same family as the steps of business processes. Software episodes can easily be embedded in business processes. Another reason is that such processes have proven to be one of the most applied techniques for such a representation, because they often help to streamline the practices of work and its organisation, sometimes even dramatically. Process thinking has even become the main rationale behind most Enterprise Resource Planning (ERP) systems used worldwide. Business processes have been accused of rigidity. We want to augment the domain of processes in just two steps. First, the actors must be able to meet increasing uncertainty. It is not enough to follow the process step by step; attention should also be shifted to the expected outcome of the work. This focus increases responsibility, but it is possible only if the actor takes the freedom to add some extra steps needed in the process and/or modify the existing ones appropriately. This augmentation of processes comes close to the situated action suggested by Suchman (1987).

Then, the actor is allowed to apply all her experience, skills, and other facilities that we call aspects of the inner work life. We believe that such contribution of subjectivity and personality will improve the quality of the outcome. This kind of subjectivity requires reflection (Schön 1982), through which the actor follows the progress of her work. There are two important moments in this continuous reflective awareness, namely, at the beginning and at the end. Work starts with articulation (Schmidt and Bannon 1992) when the actor makes it clear to herself what she is going to do and also outlines the procedure she is going to follow. At the end point, she makes an evaluation when she compares the actual outcome with the articulated image of that result. These intentional aspects are the first features we wanted to include in the integrative concept, 'Work Role'. In terms of Activity Theory (Kaptelinin and Nardi 2006) the work role

corresponds to the layer of activity, whereas the business processes belong to the action layer. On the other hand, computer programs have many properties of operations. The work role also has a clear resemblance to the concept 'practice' (Ehn 1988).

Even if business processes were evaluated as an insufficient framework for the representation of work, we do not want to reject them entirely. We regard them just like typical to-do-lists: They document all the tasks you must do or you have failed (Handy 1990). This focus acknowledges the strength of business processes, but also reminds us that processes alone cannot be enough as the only representation

3.2 Collective work

Collective work requires articulation at two levels: After the collective articulation, all members of the group know what each of them should do and how their efforts are supposed to be coordinated, Within this framework, every member continues with the articulation of their individual share of the joint outcome. In bureaucracy, collective articulation is rigid, based on the specialisation of each member, coordination is hierarchical ideally with no horizontal communication. In its extreme clarity, bureaucracy is a usable benchmark that gives us a list of aspects that must be taken care of in all coordination attempts, when we want to find different solutions for them. Bureaucracies are not entirely bad, as we can learn something about equal treatment of all clients, employment based on competence, and the clear structure of responsibilities.

While uncertainty does require reflective re-articulation at the individual level, that same flexibility obviously will also be necessary for collective work; all coordination must be modified during the work. Such dynamic re-articulation is from my interpretation the most significant issue that the CSCW movement (see e.g. Dourish and Bellotti 1992) has promoted now for over three decades, namely, how to create tools and techniques to support the dynamic re-articulating of both individual and collective (who does what?) articulation.

The work role is the central concept for understanding collective work. It can be used as the basic building block for a division of work and its coordination. It is the locus of knowledge and skill for the work proper and its reflection, for using information systems, and for integrating the external and internal aspects of work, such as commitment and responsibility.

Work has two sides, namely, external and internal. The internal side of this coin deals with details that are not visible or controlled by outsiders, often because they do not matter for the outcome. This is a natural domain of autonomy, which is to be applied in both individual and collective work. For individual work, we can directly identify a subject for living with such autonomy, but the notion of collective subject needs also to be defined and articulated before the benefits of collective autonomy can be collected. One step in this definition to ask the question: How can we know that the collective outcome is accomplished? This answer leads to the next question: Who should know this? For the time being, we do not have clear answers to these questions, but the first move to get them might be to assign the latter duty to the manager of the group. Then we could ask who could do that task if we do not like the managerial hierarchy.

3.3 Service

Service as outsourcing. Services have two parties, the producer and the customer, and they are in an asymmetric relationship with each other. This relationship is dissimilar to the concept of collective work; it is based on the contract after negotiation between the parties with different or even conflicting interests. Both parties have processes and practices of their own—only temporarily are they intertwined during the actual delivery of the service. Service is justified by the added value it creates, added value to benefit the customer.

There are many approaches to services. For instance, Stickdorn and Schneider (2013) suggest that the added value of the services is co-created by the parties or even other stakeholders. It is fine if this happens, but it should not obscure the responsibilities of both sides agreed to in the contract.

In Work Informatics, we assume a customer-centred view. The customer identifies some part of her processes and decides to outsource them. Instead of undertaking the tasks, she invites external actors to do them for her, receiving an agreed compensation. The decision-making follows the dilemma between MAKE and BUY and often follows the advice given by Transaction Cost theory (Williamson 1981). There are, however, two obvious points for co-creation: (1) co-creation is likely to happen during the articulation (i.e., the negotiation) phase or (2) during the service design before actual customer contact.

Self-service. Self-service is the consequence of the decision not to outsource. It is often supported by a material product; e.g; by a car. IT artefacts have a peculiar characteristic wherein the user does not perform the computer-supported tasks manually since the software instructions do the tasks for her. Seen from this perspective, the user has outsourced these tasks. However, there are no external actors for doing the tasks; actually, the user herself must be seen as the actor in this self-service mode. For example, in my text-processing program, I can execute the feature of hyphenation for an active text file. Use is thus interpreted simultaneously as outsourcing and in-sourcing.

e-Services. Information technology is today mostly used as self-service. The use of IT processes also relies on a well-established infrastructure. No longer do we need many types of specialised service providers like we did in the early days of computing: Keypunch operators, machine room operators, data transmission operators, network operators. We perform most of these functions as self-services, using the infrastructure that is already there and just waiting for us to wake that structure up and deliver exactly the services we need. Sometimes we give a name 'sleeping labour' to that potential of software to be integrated to our work processes. There is no real person waiting us to order these services, unless there is a serious breakdown situation, which then makes these invisible work roles visible again. This scenario means that service delivery is liberated from the requirement of the simultaneous co-location of both parties. Internet transcends place, and the 24/7 availability of electronic services transcends the time scenario. On the other hand, only well- structured and standardised service processes are feasible for e-services.

e-Health. In health care, this customer-centred service concept implies that the customer (patient) is the owner of all her care paths. She most often outsources the diagnosis (articulation of the care) and most demanding clinical operations. Many long-term care paths include phases of

rehabilitation with exercises and attention paid to healthy habits of living (restrictions on eating, smoking, and drinking). Rehabilitation transactions are ones that nobody else can do for the customer. In addition, these care paths include many governing transactions, such as transportation to the point of care, time reservations, buying medicines, getting financing to the caregiver, etc. Even some governing tasks can be outsourced although most adults are capable of doing these themselves. The ownership of the care path also implies ownership of the patient data.

4 Discussion

4.1 Knowledge of IS use and its research

Work Informatics is the culmination point of my work. It has been developed step by step as a thought experiment. The challenge has been was whether it is possible to produce a consistent conceptual construct by interpreting the use of IT as the work of its users without assuming the computer as an actor in its own right. The proof of the possibility or existence is methodologically simple. It is sufficient to show at least one case that is successful. However, we have more than a dozen cases to demonstrate this possibility. What makes a case successful? We decided to ask the users, the people who gave us their information and learned that this evaluation has a few levels as follows

- Is the interpretation possible? (Obviously yes, since we could show and explain it)
- Is the interpretation understandable?
- Is the interpretation acceptable?
- Is the interpretation useful?

In most cases, we checked all levels and received positive answers. For example, "If I had known that my way of doing this transaction will create trouble for my fellow workers in the neighbouring department, I would never have done it that way." (A user in one site of the project *Knowledge and Work 1988)*.

Work Informatics has been presented (Nurminen 2006) also to the scientific community; e.g; as an operationalization of Social Informatics (Kling 2007). Personally, I believe that the introduction of the three modalities of work gives greater analytical power than the all-embracing concept 'Web of Computing' that was coined by Kling. The attempts to spread the main ideas of Work Informatics have not been a great success. Work Informatics is currently flourishing only in Turku. On the four-step scale listed above, the author is competent to partially evaluate only the first step. Further, the section about WI in this paper more or less demonstrates passing the first step. Understanding, acceptance, and usefulness are steps that must be assessed by the audience. Many individual scholars have passed the test of understanding, at least in their private discussions. The missing breakthrough of WI in the IS community suggests that the audience

has not yet been convinced about the acceptance or usefulness of the WI approach, so it is not easy to decide which of these thresholds is higher than its compatriots.

On the other hand, why should the research community apply the same criteria of evaluation as those for the research objects? Of course they should! This is quite obvious to me, because I am frightened of thinking of the consequences of any differentiation in terms of equality. Researchers have an epistemology of their own that is different from that of the workers. I have a clear preference for the idea that they share the same reality in the work organisation; it is the same and indivisible for everybody even if that epistemology can be seen from different perspectives. This suggests that we should keep at least a certain degree of objectivist epistemology and ontology.

For example, in one case, namely the organisation in a warehouse of products, the main IS function was the recording of all stored products with the pure intention of reality mapping; i.e.; achieving full correspondence with reality. This was not, however, the whole truth; these inventory-keeping records were actually a means of maintaining accountability for temporarily possessing the property of others. It was the reason for keeping those records at all. This activity could also be put in the context of creating added value for the service level of the company. The island of objective and rational action (processes of receiving and delivering) was thus set in the context of intentional human activity, and its usefulness for the activity was based on its objectivist characteristics.

For Toulmin (2001), rationality is embedded in a broader, humane, and compassionate reasonableness. Aristetolian tradition distinguishes between three types of knowledge: episteme, techne, and phronesis. The contemplative knowledge (episteme) was the most central aspect of the encyclopaedists of the 18th century: all concepts should be positively defined in the dictionaries. Techne, which is knowledge oriented to the practical doing of things, on the other hand, could define the core competence of system developers. Phronesis enables people to act wisely and intentionally, and it stands for many aspects that we have been promoting under the title of *inner work life*.

We have now outlined an epistemological scale between rationalism and reasonableness (indeed, close to phronesis). It seems that we still have to select one point between these two extremes. This is what Work Informatics refuses to do, as instead of either-or, we prefer both-and. We appreciate rationalist thinking and want to benefit from its strong sides, but it cannot be left alone without the human control given by reasonableness. This decision resembles the choice that we made with business processes; we do not resist or reject process thinking, but we cannot accept it as the whole truth either. Rather, responsible actors must bring both reasonable and flexible features to the application of rationalist models. This holistic both-and-orientation is the glue that binds the pieces of WI together.

We find this both-and-dualism even in the balance between tacit knowledge and explicit knowledge. We need both, but only tacit knowledge is operationally usable, as the actor must read the manual and make its contents tacit (internalised) before she can make effective use of the instructions. Another example, planned action, is also situated, by definition; here the situated action is the dominant category over the planned one of this both-and dyad. On the side of dual taxonomies, some triads are interpreted as perspectives that can be and usually are present in all three. For example, the three modalities of work are such, as well as the categories of activity, action and operation that appear simultaneously, each then emphasising certain aspects

of the situation. The three perspectives of Systems-Theoretical, Sociotechnical and Humanistic (Nurminen 1988) are applied in the same manner.

Phronesis is also one point of departure in the research projects (1990's) with and their objectives of organisational implementation of new information systems. We did not want to teach the future users how the system and its functions should be used; rather we want to tell them how they can get their work done by means of using the information system. I believe that a similar intention is also behind the movement called 'Participative Design' (PD). PD is one of the most powerful procedures for integrating Phronesis-type knowledge into information systems development in a living form:; i.e.; the participant or users carry it.

On the other hand, there are many quite good information systems in use that have not been designed participatively. Thus, in spite of its huge potential, PD does seem to be neither necessary nor a sufficient condition for creating well working information systems. The coexistence of different types of knowledge offers a promising approach for knowledge management, perhaps the most influential movement regarding epistemology. If tacit and explicit knowledge are two sides of the same coin, then the problem of knowledge transfer addressed by Nonaka (Nonaka and Takeuchi 1995) may be solved straightforwardly. The core problem, however, still does remain to be solved, namely, the mediation of that part of tacit knowledge that not even its possessor knows she has or cannot formulate in an explicit form. The notion of the work role in WI may be useful in solving this problem because it encapsulates the role-keepers' knowledge independently of its type. The approaches used in the other significant epistemological movement, Organisational Learning, come close to our inclusive both-and thinking in terms of its basic premises (Senge 1990). The strong interest shown in general systems theory, known for its intensive use of formal representations, does not dominate the overview, but rather, it has a proper place as one of five disciplines.

I often have mentioned my work as a political activist. Where is it seen? I have not been a member of any political party, because I think that such membership would jeopardise the impartial role of my research work at any publicly financed university. The research itself is political activity. The core action is making information systems visible and transparent. There is the political dynamite. For example, the worker comprehends the information system as a network of messages. All information is seen as organisational coordination. If the employee must deliver information to the system, she should be able to see it as reporting to or monitoring other persons in their work roles. A visible coordination structure also makes the power structure visible. Then, the stakeholders (holders of related work roles) can assess whether they are satisfied with the power structure or whether they want to change it to fit the interests of labour unions, business owners, or the workers. This kind of transparency and competence can produce significant emancipation and empowerment of the users. This is my dream.

It should not come as a surprise that dreaming is part and parcel of all research work. Invention and innovation are driven by an image of something that does not (yet) exist; i.e.; a dream of the researcher. In some research approaches, that dreaming is systematically utilised. The dialectical method first describes the current situation (thesis). The problematic situation is described as the contradiction (antithesis) to the current circumstance. The search for the solution leads to a synthesis. Synthesis is often not a compromise between thesis and antithesis, but it is often formulated 'neutrally' and at a higher level of abstraction. As soon as the current situation can be seen as a special case of a more generalized problem, then a broad spectrum of

alternative solutions can readily emerge. Lanzara (1983) distinguished between problem-solving and problem-setting in IS development. Then synthesis places the original contradiction into a new perspective much in the same way than social interpretation is used in work informatics.

4.2 Moving toward alternative frameworks

The game played with alternative realities reminds me of the symposium that Christiane Floyd with her friends organised in a German castle in 1988 (Floyd et al. 1992). The participants were invited to play various roles in a theatre performance; I received a role in which I could play my clarinet. The mainstream reality was challenged in multiple ways over the entire week; e.g; in a magician's presentation. Another formulation of similar relativity can be found in the title of a book written by Arne Næss (1982) *Hvilken verden er den virkelige*? (*Which World Is the Real One?)*

Work informatics puts the emphasis on use rather than on development. Therefore, we have not presented an information systems development methodology (ISDM). That does not mean that WI could not be useful for supporting organisational change. The domain of change now should be dramatically broader than it is in most traditional ISDMs. Advice is given for creating a social interpretation of the current situation. Any comparison between it and the reality has usually initiated a self-steering process for solving observed problems. This focus is illustrated in Kurt Lewin's famous dictum "there is nothing so practical as a good theory." Theory cannot be turned into practical action unless the subject understands the theory well. Another difference is that change is not originated by the introduction of a computer system. Rather, the activity, its organisation and coordination are designed first; then the technical system is (re)designed, if or as needed. The notion of a work role is useful in this overall design, since it includes the contents of the work and its organisation, and it also designates the use of the information systems. One challenge for WI is that we should determine the requirements for an information system to qualify as WI-oriented information system. How should such a system look?

I have had the privilege to continue my teaching activity at my home university (Turku) by giving lectures on Work Informatics even after my retirement, in collaboration with Jukka Heikkilä, now the Professor in Information Systems/Work Informatics in my old position. During the years after my retirement we have further developed many of the main ideas of Work Informatics. These innovations support many of the recent developments in e-services. For example, Work Informatics seems to have rather strong explanatory power for emerging platform economies. We have also successfully applied WI to finding novel practices in health care. Work Informatics may also guide the new architecture of Internet use in the spirit of the eMe-approach introduced in Borås and their intention of turning around the Internet (Albinsson et al. 2006). Today, customers log on to multiple sites of various service providers, which thus fragments the customers' processes. Why should the suppliers not contact their customers?

We aim at working to get Work informatics better known on the map of IS research. While it has been developed as a thought experiment, its early versions have not yet been systematically compared with other traditions that study work and information systems. We, Heikkilä and I, are preparing a monograph that certainly can take the first steps in this direction; it also offers a better chance for obtaining more initiative from these others.

Business potential. I hope that in the years to come some of my students will find their own business opportunities hidden in these dreams, even if dreaming is often seen as useless leisure activity. I believe that a new small company can offer valuable services of organisational implementation to many companies. Our case studies suggest that there is a need. First they could make an intervention after the fact, when (organisational) implementation has failed. In the next step, a group could take an active role during the first implementation phase to prevent that kind of failure. Finally, the ultimate reason for implementation failures may be found in a study of the design and design methodologies applied by software vendors. In the long run, these suppliers could learn to use approaches that directly conceptualise the functioning of the systems as work tasks for the users. Radically new architectures may be needed.

A few times in life I have tried to convince my colleagues about the fruitfulness of my own theorising and dreams. Perhaps the bravest attempt was the publication of the Infurgy (Inf>information, urgy>εργον work in Greek) Manifesto (Nurminen 1996), both in the *Scandinavian Journal of Information Systems* and at the IRIS Conference. During these years I have learned that the mainstream cannot be seriously challenged. Perhaps the anomalies (Kuhn 1970) of the dominant paradigm are not yet serious enough. Often I have simply withdrawn, repeating my teenage survival strategy in the lines of *Finnlandisierung*. But here it is, Work Informatics, free to be used by anybody.

Notes

1. *Finnlandisierung* is a pejorative name for the foreign politics of Finland toward the former Soviet Union, in particular from the 1960's to the 1980's. The core of this politics was proactive, and it aimed at avoiding open conflicts with the then stronger party.
2. A video clip "Computer music in 1967" is available on YouTube: https://youtu.be/G-s7du4f0js
3. Irmeli Sinkkonen was then working as the head of the Usability Lab at the Helsinki University of Technology, Espoo, Finland, so she used to append this aphorism at each sent e-mail message as her signature.
4. In this chapter I continue using the narrator speaking in the first person. The shift from singular to plural form indicates that there are multiple members of our research groups over years who have contributed to the conceptualisation work.

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