Scandinavian Journal of Information Systems

Volume 1 | Issue 1 Article 6

1989

THE IMPACT OF WORK DEVELOPMENT ON INFORMATION SYSTEMS

Karl Kuutti
University of Oulu, KarlKuutti@emailaddressnotknown

Follow this and additional works at: http://aisel.aisnet.org/sjis

Recommended Citation
Kuutti, Karl (1989) "THE IMPACT OF WORK DEVELOPMENT ON INFORMATION SYSTEMS," *Scandinavian Journal of Information Systems*: Vol. 1 : Iss. 1 , Article 6.
Available at: http://aisel.aisnet.org/sjis/vol1/iss1/6

This material is brought to you by the Journals at AIS Electronic Library (AISeL). It has been accepted for inclusion in Scandinavian Journal of Information Systems by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Scandinavian Journal of Information Systems, Vol. 1, pp. 162–176, 1989

THE IMPACT OF WORK DEVELOPMENT ON INFORMATION SYSTEMS

KARI KUUTTI

Department of Information Processing Science at the University of Oulu
Linnanmaa, SF-90570 Oulu, Finland

Abstract

The historical development of work is analyzed using the division into conception and execution aspects proposed by Braverman. The result is compared with the historical development of information systems. It is found that although the support of group conception is needed in the developing work organization, no information systems yet exist for this purpose. Some features needed in such systems are presented.

Keywords: information systems, work development.

Published by AIS Electronic Library (AISeL), 1989

1 Introduction

It is a widely accepted vision that we are living in an era of significant change. "In all developed economies, major transformations of market structures, production technologies and production organization are presently going on." (Naschold 1987). One of the central issues in this change is the relationship between information technology and work. There has been much discussion about that relationship within the information systems (IS) research, dominated by a technological or economic determinism, in wchich the economic interests and the nature of technology is held to dictate the character of work. This view has been criticized as too narrow, and broader approaches have been suggested, e.g. (Iacono & Kling 1987, Malone 1987, Butera & Thurman 1984).

It is apparent that there are several different, at least partially independent factors shaping the development of work. Given this variety, the difficulties encountered in creating a general model for the relationship between work development and information systems are fully understandable. One simply has to select a particular point of view.

The selection made in this paper goes as follows:

- The general structure is determined by national and international economic factors such as line of business, competition, markets, division of labour, etc.
- The range of possibilities for action is determined by technological development.
- The final outcome is shaped (within the possibilities and the general frame) by socio-political factors, such as the relationships between different power groups etc., and the activity of different groups of actors.

The starting point of this paper is the fact, that the work activity is a primary object and information system a secondary object: there is no information system without a hosting work activity. Thus it could be useful to study the historical development of work, since one might then also gain a better insight into the development of information systems.

The structure of this paper is as follows: First a general model for the historical development of work is evolved, based on a couple of categorizations from work sociology (section 2.1 and 2.2). The model is then applied to the recent situation (section 2.3). The historical development of information systems is then compared with the model (section 3), and finally, some conclusions are put forward (section 4). The main result is that there seems to be an asynchronization between the development of work and that of information systems, so that the changing needs of work have not yet been recognized clearly enough in the design of information systems.

2 On the Historical Development of Work

2.1 Conception and Execution Aspects of Work

In his classical critique of taylorism, H. Braverman writes:

> In the human, as we have seen, the essential feature that makes for a labor capacity superior to that of the animal is the combination of execution with a conception of the thing to be done. But as human labor becomes a social rather than an individual phenomenon, it is possible ... to di-vorce conception from execution. ... This should be called the separation of conception from execution, rather than by its more common name of the separation of mental and manual labor (even though it is similar to the latter, and in practice often identical). This is because mental labor, labor done primarily in the brain, is also subjected to the same principle of separation of conception from execution: mental labor is first separated from manual labor and, as we shall see, is then itself subdivided according to the same rule. (Braverman 1974, pp. 113–114)

Thus, according to Braverman, it is possible to separate conceptually three aspects of work: manual execution, mental execution and "pure" conception. In the initial, natural state they are all united. When the natural unity has been broken and conception first separated from execution, the latter also becomes a possible object of mechanization and automation. There is just the "pure" conception, which it is in principle not possible to automate. It is the "planning" of work, the answering of the questions: "What kind of situation is this?" and "In this situation, what should be done and how?"

2.2 Historical Ideal Types of Work

Another conceptual tool to be used is a model of historical types of work put forward by the s.c. "Developmental Work Research Group" in Finland (Figure 1). The categories described in this model are idealized types or layers, not distinct, separate successive "phases" in the history of work. Newer forms have not suddenly replaced the older ones, but have been created inside them. Different layers in practical work can and do co-exist in the same organization, even in the same workplace. This has always created tensions and contradictions.

The term "craft" means a spontaneous type of working, in which the methods and tools develop or have been developed mainly in practical situations. Using the terms of Braverman, conception and execution are still united in this type. An archetypal work organization is the masterapprentice relationship in traditional handicrafts, where a novice learns the tacit knowledge for conception and skills for execution during his apprenticeship by growing into that particular work culture. The "craftsman" is the real subject of his work, because its outcome and process are guided by his motives.

Published by AIS Electronic Library (AISeL), 1989

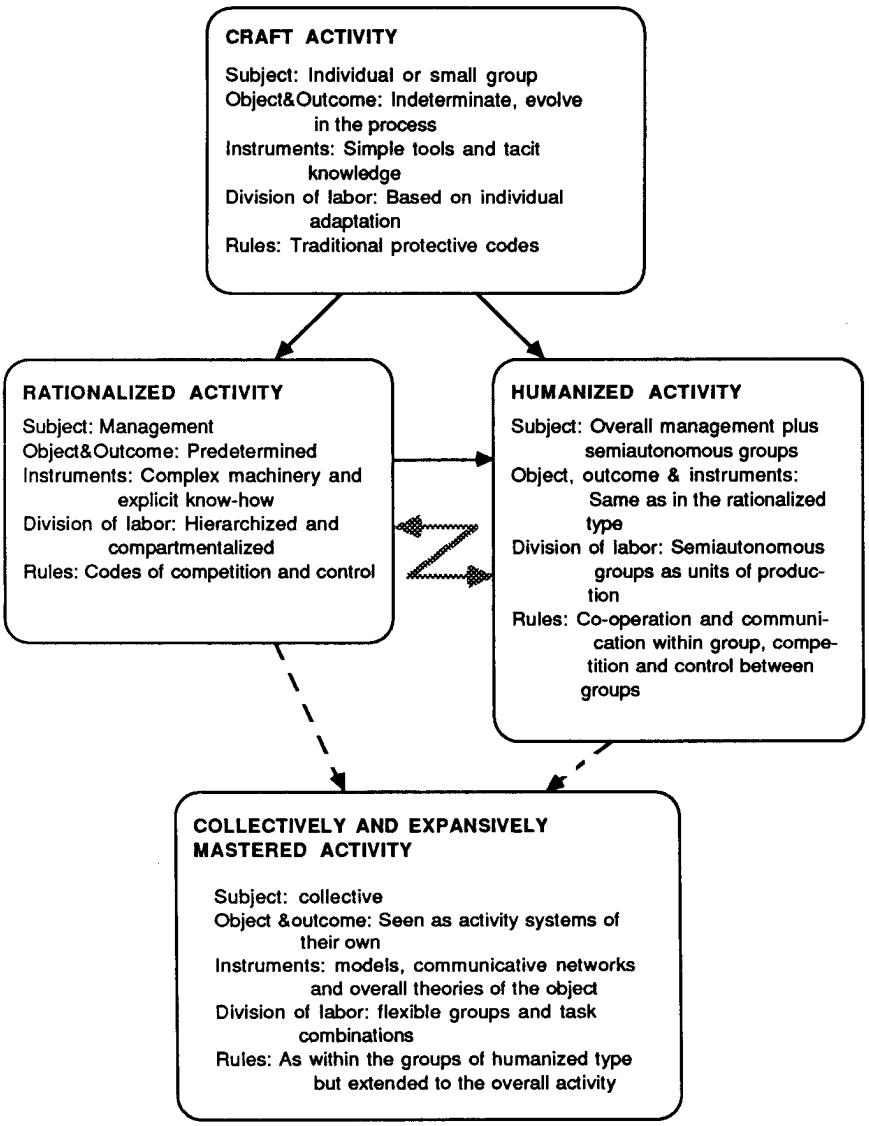

Figure 1: The historical types of work, after (Engeström 1987, p. 284). The black arrows indicate preceding dependency. The gray cross-arrow indicates contradictory relationship between appraoches.

The term "rationalized" refers to the type of working which has evolved since the beginning of the industrial revolution and whose ideas are perhaps most clearly stated in the works of F. Taylor ("scientific management"). Even though taylorism is no longer very popular, most "shopfloor" work can still be assigned to this type. Tacit knowledge is not sufficient, but the knowledge concerning the work must be collected and objectified, often at the level of scientific reasoning. The objectified knowledge is materialized many times over in different machines. The real subject of work is the management, whose motives guide the outcome and process. A well-known problem of "rationalized" work is alienation—difficulties in maintaining the motivation of workers who have no control over their work process or its results. This has caused problems of quality etc. According to Braverman, the crucial idea of scientific management is the strict separation of conception and execution: "All possible brain-work should be removed from the shop and centered in the planning or layingout department..." (Taylor, cited in Braverman 1974). The archetypal organization of work is the assembly line, where the work consists of simple operations and the pace of work is determined by the line.

The term "humanized" work refers to the type of working, which has evolved in opposition to the rationalized type and as an answer to the problems created by it. Its origins lie in the 'sociotechnical' school. This approach directs attention to the "human resources" of an organization and attempts to motivate the workers better by giving them more control over their work. There are two major levels in humanized work: (1) arrangements at the individual level, like job rotation, job enlargement and job enrichment, and (2) more fundamental work reorganization, typically the forming of semiautonomous work groups in which also some parts of the design and planning of the work process are done by the workers themselves. The autonomy is restricted to the working process, whereas the workers have no influence on product design etc. (In one survey none out of 21 established work groups around the world had any control over the product and only 2 groups had some influence on the volume of production (Rohmert & Weg 1976, cited in Julkunen 1987)). The management is still the major subject. In the terms of Braverman, some conception concerning the process has been "given back" to the workers in this model.

The craft, rationalized and humanized forms of work are real, existing forms, but the fourth type, "collectively and expansively mastered" work, is more of a developmental ideal. Here the autonomy of workers is extended to contain the whole work activity to the extent that they can change and shape both the products and the processes, and even establish totally new goals. In the terms of Braverman, the unity of conception and execution is established again, but on a considerable higher level than originally:

- the conception takes place at the group level, not "in the head" of a single individual,
- the conception is based not only on tacit knowledge but on communicable,

Published by AIS Electronic Library (AISeL), 1989

objectified knowledge, and

- the conception is conscious, reflective and able to use conceptual augmentative tools, like models, communicative networks and overall theories of the object.

It is evident that the rapid development towards the fourth type is in general impossible, because it entails the principle that workers themselves should be able to formulate the goals of the organization, use all available means for planning (including scientific means) etc. A radical change in power structures would certainly be needed before any like this could take place. Even so, if it is a "more advanced form" of work organization, as the model suggests, we should be able to see some development in that direction.

2.3 The Recent Situation and the Model

The path of development traced here started from craft type, in which conception and execution were united—but at the unconscious level. In the tayloristic work organization the main theme was to separate conception and execution totally. "In the beginning, the office was the site of mental labor and the shop the site of manual labor. This was even true, as we have seen, after Taylor and in part because of Taylor: scientific management gave the office a monopoly over conception, planning, judgment and the appraisal of results, while in the shop nothing was to take place other than the physical execution of all what was thought up in the office" (Braverman 1974, p. 315).

This has not been entirely possible in the practice, however, because man is not a machine, there are always elements of conception is his work, and on many occasions those elements are obligatorily needed to ensure the fluent operation, e.g. for preventing errors. Conception and control are a highly essential element in many jobs, e.g. in machining, which has had a strong craft flavour—even inside an otherwise tayloristic work organization.

In the humanization type some conception has been given back to the workers (see, Figure 2).

What are the most fundamental new features in the recent situation? Only the economic and technological levels are considered in this paper.

On the economic level, the international division of labour is in a state of change. Because of competition from countries with a cheap labour force, the tayloristic work organization no longer possesses enough productivity potential in the developed countries, and something else is needed.

On the technological level, automation offers some possibilities for overcoming the problem. There seem to be two main approaches: development towards a fully automatic factory and development towards skill-based production.

The facilities offered by computer have now made it possible to eliminate the last islands of conception and autonomy from the shopfloor and proceed towards a fully automatic factory—the ultimate version of taylorism. The few workers

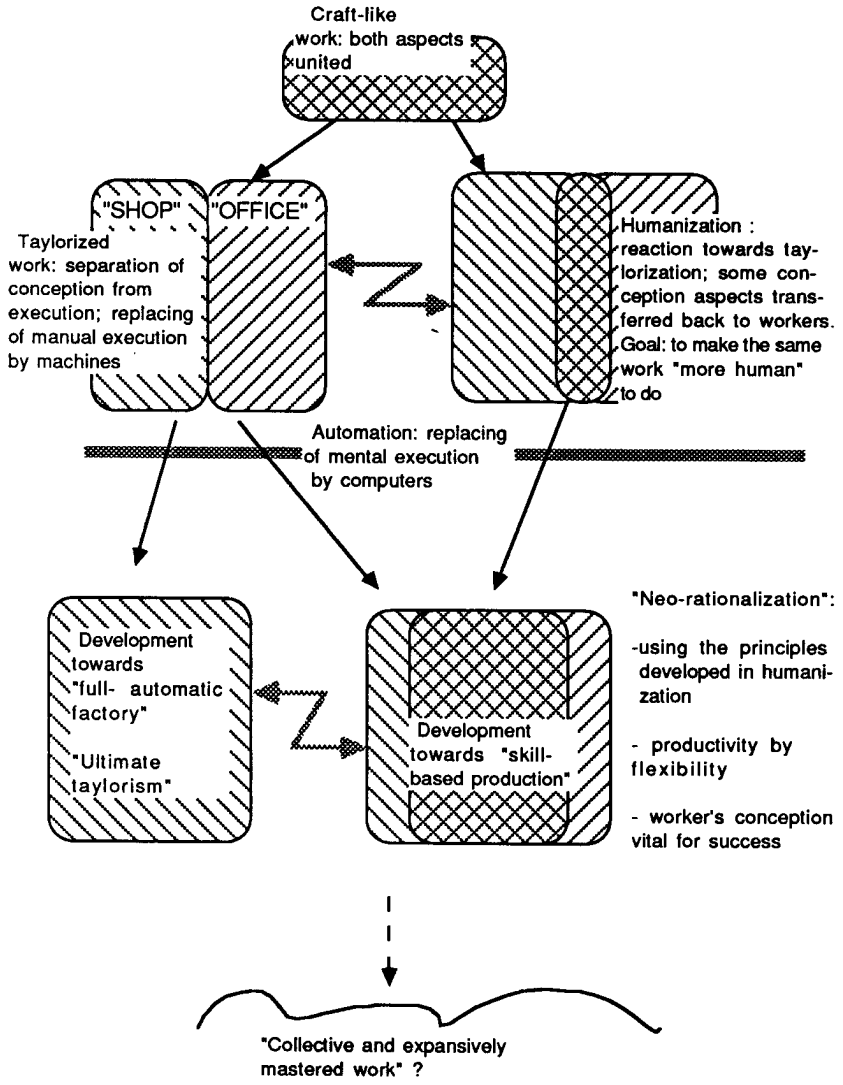

Figure 2: Automation and work. The model in Figure 1 has been developed to contain a new subphase, caused by automation. The conception–execution categorization has been used to clarify the differences. The contradiction between the new approaches is even more deep than that between the older ones.

still engaged in production are responsible only for low-skilled operational tasks. Jaikumar (1986) criticizes this kind use of automation as "paralyzing".

Skill-based production takes the opposite approach: it tries to make efficient use of the same workers who were rejected in full automation. It is based on the idea, that the tayloristic work organization involves a considerable reserve of resources which have mostly remained unused—all the conception abilities of the workers. In skill-based production the key concept is flexibility, which can be achieved in automation only through using the conception of skilful workers. For example, workers are encouraged to make process or product improvements etc. This means, that they have to perform some "managerial" and "planning" tasks, previously carried out in the office. They also have to perform the tasks together, so that everybody can contribute to the flexibility of production. (Although there have been much claims about the innate flexibility of automation technology the real situation is at least problematical, in that experience gained in software production tells us that the more complex the control structure has to be, the less flexible and more error-prone the result tends to be. This has been noted also by (Kern & Schumann 1984)).

Utilization of the worker's conception is not possible without an appropriate work organization. It has been found that those forms of work organization which developed during the humanization phase will support the use of conception and apply well also into this situation. "In many ways the new wave of research is merely rediscovering the ideas of the 1950s and 1960s. This is not merely a pendulum's swing, however. It reflects the extent to which the reality has caught up with theory" (Adler 1986, p. 13). Also (Kern & Schumann (1984) have similar vision. This new application cannot be called "humanization" any more, because the goal is simply to make the work more efficient. It could best be called "neo-rationalization".

Even though the automation and the necessary new organization of work offer new possibilities, jobs under the "neo-rationalization" will not automatically be of better quality or more "creative". The final result will be shaped by many situation-dependent conditions of application, e.g. in the economical and socio-political spheres. Besides, the subjective experience of "creative" work can be even more stressful than that of the tayloristic type of work.

3 IS and the Computerized Support of Work

For simplicity, only the "office" side of work is examined in this paper, and not the connection between IS and the actual material production. When examining the development of the computerized support of work, a pattern can be outlined which shows some similarity to the general model. Again, the "phases" are not mutually exclusive, but coexist in everyday practice (Figure 3).

Naturally the real historical development has been much more varied. The "steps" are described more accurately in the following.

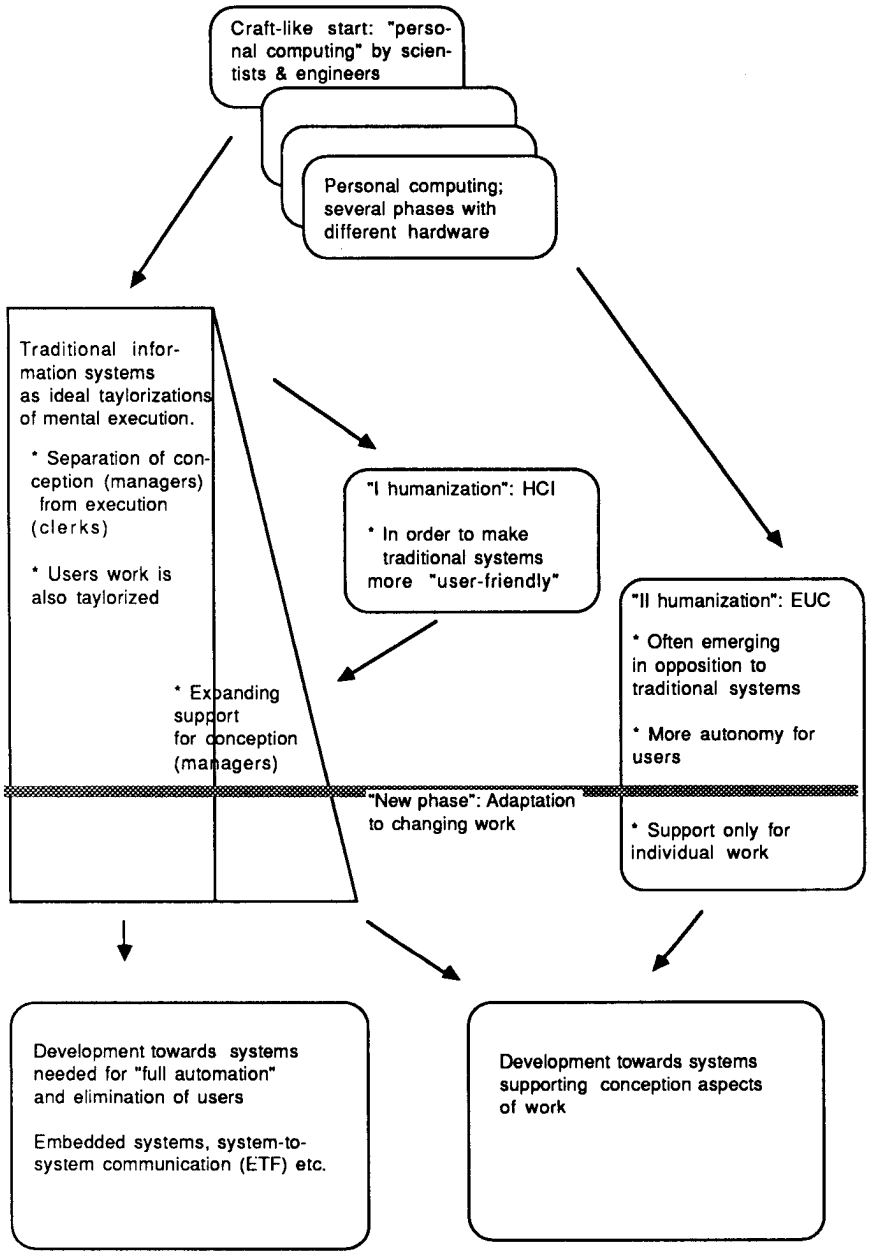

Figure 3: The historical development of IS use

3.1 A Craft-like Start: "Personal" Computing

The way in which the very first computers were used can—at least in some sense—be described as "craft-like": the users were individual scientists/engineers with research-like tasks of their own, and although there was an established body of scientific knowledge in areas where the work had to be done (mathematics and physics, military purposes), knowledge of how to use computers and numerical methods developed in everyday practice. The use and development of computer programs were closely intertwined during the first craft period. Later they have been separated, but the personal nature of computing has been in any case conserved in programming and development work. The personal computing phenomenon has gained new stimuli from time to time because of technological development: time-sharing, minicomputers, micros, etc.

3.2 "Traditional" Information Systems and Taylorization

According to Braverman's definition, the office is the place for mental work, and it is there that conception and execution can be separated. If there are repetitive, routine tasks inside the execution part it is also possible to mechanize them, just as happened in material production. Traditional information systems are mechanizations of that mental execution. A computer is indeed an ideal tayloristic labourer : it is accurate and does only what it has been told to do and always as fast as it can. "The reasoning behind such applications is essentially the same as that applied to Ford's early assembly plant. The aim is to replace human effort and skill with a technology that enables the same processes to be performed at less cost and with more control and continuity." (Zuboff 1985, p. 8).

A considerable part of the work process is so totally taylorized, and the tasks left to humans have also been taylorized, because "the machine has been allowed to select first" (Nurminen 1988).

This development started in the early 1950s, when punched card sorters and adders were replaced by computers in existing applications such as pay-roll functions, accounting, etc. (Vitalari 1978), and information systems have since passed through several stages, in which their functionality has continuously increased.

Traditional information systems have a dual nature: although the backbone is the automation of mental execution, there has also been a growing tendency to produce knowledge for conception. "By its very nature, then, information technology is characterized by a fundamental duality that has not been fully appreciated. First, the technology can be applied to automate operations. ... Second, technology can be used to create information. ... Information technology can make a powerful contribution to the objectives of increasing control and continuity, but its uniqueness lies in its informating capacity, which can enhance comprehension of the operations through which an organization does its work." (Zuboff 1985, 8-9).

3.3 The "First Humanization": Human-Computer Interaction

It seems reasonable to call the rise of the "User interface"-movement (Man-Machine-Interaction, Human Factors etc.) the first attempt to "humanize" information systems, because it had goals similar to those manifested in job humanization: to make the existing work/the traditional information systems more acceptable to do/use—without any essential changes in the work or information system itself. Like work humanization movement, it was also propelled from the outside rather than by system users themselves.

3.4 The "Second Humanization": End-user Computing

The concept of end-user computing (EUC) is rather loose, and it is rather difficult to make a strict distinction between it and personal computing. The main difference may well lie in the different organizational context: the using of computers and IS is accepted as an essential part of one's work, not a personal matter. The using of information collected for and by the organization is also a new feature.

In practice, EUC has a rather similar relationship with traditional systems to that of work humanization with tayloristic organization: it adds more autonomy and responsibility to the user's work. Also, like work humanization,the development of EUC, too, had a flavour of opposition about it. A lot of conception aspects of work are also needed, especially concerning the work process.

There are a couple of important differencies, however. First, no popular tools for a "semiautonomous group" have been developed. Second, EUC has often been initiated by the users themselves as an answer to problems—e.g. the lack of support for work given by traditional IS. This means that there new conception demands already exist in work. Thus at least a part of EUC belongs to the "new phase".

3.5 The "New Phase": Emerging New Demands

The development of traditional information systems will continue in the "new phase". There is no evidence of their fading away! They will even develop towards more automatic systems, as the emerging ETF (electronic transfer of funds) and inter-organizational systems are showing.

The need for a different type of system can be also recognized. If work is changing in a direction, in which use of the conception of the workers is vital for success and this work needs to be organized in the form of semiautonomous, self-steering groups, then systems supporting the conception aspects of group work will be needed. This means that different emphasis will be needed: "In this vision, the organization becomes a learning institution for which a fundamental objective is the expansion of knowledge about the business and the opportunities it faces." (Zuboff 1985, p. 16). Goals of this kind cannot be achieved using traditional information systems alone.

Published by AIS Electronic Library (AISeL), 1989

We have suggested elsewhere that there is a need for systems supporting research-like group learning (Kuutti & Engeström 1987). No fundamental differences are to be seen between those and the systems needed for supporting the conception aspects of work. The necessary features include:

- Information gathering from many different sources by different members of the group (whose viewpoints and corresponding information needs may vary).
- Information manipulation, model building (numerical, symbolical, pictorial, simulation etc.), rapid experimentation with models to produce new knowledge.
- Information dissemination and unification among the participants—communication to build up a common body of knowledge.

4 Conclusions

4.1 General Trend

The analysis presented in this paper is cursory indeed and can take only a few steps towards better understanding of the relationship between work and information systems. But there does seem to be some evidence, that the development of work and information systems could include the following features:

1. On the one hand, the tendency towards full automation and elimination of users will continue—e.g. in the form of inter-organizational systems—as there is still much to be rationalized.
2. On the other hand, there is a growing need to integrate conception and execution aspects more and more into the same jobs. This means that we will see "managerial" and "planning" tasks moving towards "lower" job positions. This will—at least in some cases—radically change the role of "end-users" and their needs for information systems support.
3. The need to support the conception aspects of work will continue to expand. Especially critical will be support for common conceptions inside working groups.

The last aspect can be used to explain the evolvement of the office automation systems, for example.

4.2 Office Automation and Computer-supported Cooperative Work (CSCW)

The first attempts to "automate the office" were made using the same approach which had worked very well with traditional information systems: replacing the

mental and manual execution carried out in offices according to well-defined procedures. This approach did not work well and can be considered to have been a failure, see (Hirscheim 1985), and emphasis in the development later changed more towards supporting the work than automating it.

According to the interpretation presented here, the initial assumption about the nature of office work is a fundamental misconception. In the primary tayloristic division of labour, the most essential responsibility of the "office" concerns the conception aspects of the holistic work process, and all the other possible tasks are subordinated to this. There are tasks of routinized mental execution which can be automated, but these belong to the area of "traditional" information systems, which are in fact real "office automation". The tasks outside "traditional" systems in offices are so closely connected with the conception aspects of the holistic work process that they are very hard or even impossible to automate independently. Failures in automating such tasks are unavoidable.

In addition most attempts to automate office work have been at the level of the individual worker and not at that of the working group.

This lack of understanding of the nature of office work has been well recognized as a problem. The result has been a growing volume of research, in which office work is analyzed using a diversity of viewpoints, as social organization, intra-office communication etc. Research based on the various theoretical frameworks has thus far been more analytically oriented, and not much constructive, practical advice has yet been generated.

The research now being done into Computer Supported Cooperative Work (CSCW) can be seen as an unintentional answer to the problems of office automation research. First, it addresses directly the most urgent need to support the work of groups. Second, it is exploratively and experimentally oriented, the main goal (and research tool, too) being in general to develop a working system for some particular support aspect.

The nature of the cooperative work to be supported is not clearly recognized in the CSCW research, as the definitions of "cooperative work" are mostly very vague. One of the most articulate definitions is that of Sørgaard (1987), who observes that the situation of CSCW use involves sharing of goals, non-hierarchial relationships, non-specialist users and relatively autonomous organizational settings, for instance. Although this definition has been considered to be too restrictive for the whole CSCW research field (Bannon et al 1988), it does describe clearly some external features of work in a semiautonomous working group. Nevertheless, Sørgaard does not recognize the difference between conception and execution aspects of work.

Even without any clear recognition of the fact, support for the conception aspects of work is emerging in CSCW research. One of the most popular research topics is "data or knowledge sharing" (Stefik *et al.* 1987, Malone *et al.* 1987, Cook *et al.* 1987, Greif & Sarin 1987), which is certainly one central part of group conception support. In many cases this research is also suffering from a lack of distinction between conception and execution aspects. Communication

Published by AIS Electronic Library (AISeL), 1989

among group participants, for example, is generally seen to be a rather non-problematic matter provided that the proper common medium is available: i.e. to receive some message is the same as to comprehend it. This can hold good only in situations with a wellknown context, but not always in situations where conception is needed. The systems under development also tend to be more or less universal, i.e. useful in some kind of group work (e.g. meetings) with any subject matter. But there is no such thing as conception in general—only conception of some particular subject matter. Thus the best support will also be dependent on that subject matter.

4.3 Further Research

The analysis suggests in general that there will be a change in the need for information systems. The automation of mental execution will remain as a backbone (and develop further), but alongside it there will be an increasing need to support the conception aspects of work. This means that systems have to be more flexible, since it is not possible to predetermine the information needed in a research-like task. The development process has to be even more work-oriented than it is now—development of the whole work activity and development of information systems will be interwoven.

For this purpose a much better and more detailed understanding of work processes and their conception aspects is needed. This amounts to a "social order" for a vast quantity of empirical research, the object of which could be the information systems development work itself, because:

- the IS development work must place a strong emphasis on conception,
- the IS development work is not strictly regulated (lack of professionalism, trade unions etc.), so that room is left for spontaneous new ways of organizing the work
- the IS development work is serving as a locus for other work development.

References

Adler, P.S. (1986). *Automation and Skill: New Directions.* Stanford University, Academy of Management.

Bannon, L., Björn-Andersen, N. & DueThomsen, B.(1988). Computer support for co-operative work: an appraisal and critique. In Bullinger, H.I., editor, *EURINFO 88.* North-Holland, Amsterdam. Pages 297–303.

Braverman, H.,(1974). *Labor and Monopoly Capital.* Monthly Review Press, New York and London.

Butera, F. and Thurman, J.E. (1984). An Approach to Automation and Work Design. In Butera, F. & Thurman, J.E., editor. *Automation and Work Design.* North-Holland, Amsterdam. Pages 9–21.

Cook, P., Ellis, C., Graf, M., Rein, G. & Smith, T. (1987). Project Nick: Meetings Augmentation and Analysis. *ACM Transactions on Office Information Systems,* 5(2):132–146.

Engeström, Y., (1987). *Learning by expanding.* Orienta-konsultit, Helsinki.

Greif, I. & Sarin, S. (1987). Data Sharing in Group Work. *ACM Transactions on Office Information Systems*, 5(2):187–211.

Iacono, S. & Kling, R. (1987). Changing Office Technologies and Transformations. In Kraut, R.E., editor. *Technology and the Transformation of White-Collar Work.* Lawrence Erlbaum, New Jersey. Pages 53–75.

Hirscheim, R. A. (1985). *Office Automation—A social and organizational perspective.* John Wiley & Sons, Chichester.

Jaikumar, R. (1986). Postindustrial Manufacturing. *Harward Business Review*, 64(6):69–76.

Julkunen, R., (1987). *Työprosessi ja pitkät aallot (The work process and the long economical waves).* Vastapaino, Jyväskylä.

Kern, H. & Schumann, M. (1984). *Das Ende der Arbeitsteilung? Rationalisierung in der Industriellen Produktion.* Verlag C.H. Beck, München.

Kuutti, K. and Engeström, Y. (1987). Intelligent CAI-systems and the emergence of learning activity. In Proceedings of 2nd Intl. Conf. *Children in the Information Age*, Sofia.

Malone, T. (1987). Computer Support for Organizations: Toward an Organizational Science. In Carroll, J., editor. *Interfacing Thought.* MIT. Pages 294–324.

Malone, T., Grant, K.R., Turbak, F.A., Bropst, S.A. & Cohen, M.D. (1987). Intelligent Information Sharing Systems. *Communications of ACM*, 30(5):390–402.

Naschold, F. (1987). Technology and assessment. Developments, controversies and perspectives. In *Future of Work: A Viewpoint of Social Sciences.* Nordic Institute of Advanced Occupational Environment Studies, Helsinki. Pages 31–50.

Nurminen, M., (1988). *People or Computers. Three ways of looking at information systems.* Studentlitteratur, Lund.

Rohmert, W. & Weg, F. (1976). *Organization teilautonomer Gruppenarbeit. Betriebliche Projekte—Leitregeln für Gestaltung.* (RKW). Hansen Verlag, München & Wien.

Sørgaard, P. (1987). *A cooperative work perspective on use and development of computer artifacts.* DAIMI PB-234, University of Aarhus.

Stefik, M., Foster, G., Bobrow, D.G., Kahn, K., Lanning, S. & Suchman, L. (1987). Beyond the Chalkboard: Computer support for Collaboration and Problem Solving in Meetings. *Communications of ACM*, 30(1):32–47.

Vitalari, N. P. (1978). *The Evolution of Information Systems Support for Management.* MISRC-WP-78-01, Management Information Systems Research Center, University of Minnesota.

Zuboff, S. (1985). Automate/Informate: The Two Faces of Intelligent Technology. *Organizational Dynamics*, (Autumn):5–18.

Published by AIS Electronic Library (AISeL), 1989