Role-based Interpretation of ISs

Markku I. Nurminen and Vesa Torvinen

Turku Centre for Computer Science
TUCS Technical Report
No 9, May 1996

Turku Centre for Computer Science
Lemminkäisenkatu 14
FIN-20520 Turku
Finland
http://www.tucs.abo.fi/

ISBN 951-650-750-6
ISSN 1239-1891

Abstract

In this paper we present a role based approach to the analysis of computer-based information systems (ISs). The concept of work role is a good tool for representing work and division of labour, and the computer supported tasks make no exception of this. Relationships between actors, roles, tasks and computer systems are discussed from the act-oriented perspective. Role based analysis of an activity brings the problems of competence, responsibility and co-operation with the ISs into the surface.

Key words: Act-orientation, computer supported cooperative work, deployment of computer-based information systems, roles, division of labour, evaluation, responsibility

1. Introduction

Information systems are typically developed as products [11]. By means of specifications they are separated from the human activity with the purpose to create a consistent internal structure to the system. This structure does not necessarily fit without problems when the system is implemented and introduced to human activity. It is likely that many important aspects related to work and its organisation do not get sufficient attention [e.g. 3], which may imply a poor quality in the use situation.

In this paper we transcend such separation by advocating the inseparability claim/postulate [27]. It is stated that information systems should be regarded not only in connection to related human activity [e.g. 33, 23] but as an inherent part of it. The computer does not qualify as an actor. System functions can be interpreted as human acts. In words by Bannon [2] we emphasise human actors rather than mere human factors. The parts of the system are thus interpreted as work tasks performed by the workers qualified to use the new technology as a tool in their work. Thus this approach is also called act-oriented [10, 21].

As the computer-supported tasks are now seen as work tasks of the user, they also become to the object of the organisation of work. Who is supposed to perform which tasks? How are these tasks initiated and terminated? How are they co-ordinated with other tasks? As a pretheoretical understanding we can refer to access privileges as one possible means to accomplish this division of work. This leaves, however, many crucial factors untouched, among them the explicit definition of responsibilities and co-ordination.

In organisation theory and practice, the concepts "job" and "work role" have frequently been used in the analysis and design of the organisation of work [e.g. 14, 26] often even interchangeably. When the work role is defined as a smaller collection of work tasks than a whole job, it allows one person to occupy several roles, thus giving the designer building blocks of finer granularity, which is useful for making the required capacity and skill match each other. On the other hand, it also allows several workers to occupy one role; both properties together give a remarkable flexibility in the organisation of work.

In this paper we introduce the role concept to the analysis of information systems and employ the act-oriented interpretation discussed above. We lean on our experiences in several case studies in which we have evaluated the deployment of information systems in use situation. The cases studies have been documented as confidential Customer Reports by LABORIS Information Systems research group. This perspective gives highly relevant evaluations because it pays attention to the benefit for the work rather than skilful manipulation of a technical artefact. The role concept has proved to be a powerful instrument for such evaluations. The purpose of role analysis is to identify and explain difficulties in work activity through the social interpretation of ISs. In more general terms, we expect improved sense-making of the phenomenon of organisational use of information technology.

The purpose of this paper is not to provide a thorough review of the different uses of the role concept. Instead, we are focusing on the work role and we try to be as ascetic as possible. The main object of this study is to explore and articulate some of the most important characteristics of the role concept in computer-supported work.

The following section reviews and discusses earlier conceptions of role in IS development field. We next redefine the role concept from the act-oriented perspective in three phases: (1) a role as a structural concept between actors and tasks, (2) a role as a domain of responsibility and (3) the co-ordination between roles. The connection between ISs and work activity is discussed when ever appropriate. Finally, we present a conclusion, give some suggestions for practice and research.

2. Whose Role?

The concept of work role has been used in some approaches to IS development. This indicates, that such approaches are seeking for a better understanding of work activity and specialisation structures in order to build usable and useful ISs. The role concept may be seen as a part of a view of a future use situation, sometimes presented in the form of a scenario. It would be an advantage if the representations of the use situation would be same during the development and use. Concepts used in the development are relevant for our interest in the evaluation of the deployment of the IS. But how is the role defined in these approaches? Who can take a role and how is it used? In particular, we are faced with two fundamental issues:

1) Are roles something which also computers can have?

2) Can the human role be taken by a collective or is it for individuals only?

The concept of role is applied in business process re-engineering (BPR) to view how people work together to achieve business objectives. At least two modelling techniques use roles explicitly: the Role Activity Diagrams (RADs) [15] and the Role Interaction Nets (RINs) [29]. In RADs the role is 'a set of activities that are generally carried out by an individual or group with some organizationally relevant responsibility.' (p. 85). It is argued that RAD represent the logic of activity, not any physical mechanisms of it (like computers). The roles in RINs are carried by individuals, but the analysis also includes the automatic operations of computers. A third approach to BPR, the Roles-Linkage Model (RLM), seeks for representation and analysis of business networks [19]. They use the concept of business network role which is the role of an organisation in an economic system. The core of the approach is on business network redesign and electronic integration.

Oberquelle [28] introduces a conceptual framework called RFA-net which consists of three conceptual levels: the role, the function and the action level. The purpose of the framework is to form a visual language for co-operative modelling. An RFA-net covers work organisation in general, not only the computerised part. On the functional level every function is divided between man and machine.

Another model with three levels is developed by Ellis and Wainer [9]. Their conceptual model of groupware (CMG) consists of an ontological model, a co-ordination model and a user-interface model. In the co-ordination model an actor which may be a user, a computer system, or a group is playing a particular role with a defined goal.

Wilson [32] presents a Role Analysis (RA) which is 'a significant part of most kinds of problem-solving related to management problems.' (p. 278). His book is in many places based on the ideas of Checkland [6] and the Soft Systems Methodology. The RA is used to map role boundaries and to examine cross-boundary interaction. A role can be taken by an organisation, a department or an individual. The two former ones are stressed more than the latter one.

It can be pointed out that every approach above seeks to define the lines of responsibility between some units. At the same time they describe existing specialisation structures. However, the approaches can be distinguished by the notion of role they use (figure 1), in particular in respect of the assumed keeper of the role: a role can be taken by a computer, an individual, or some collective actor.

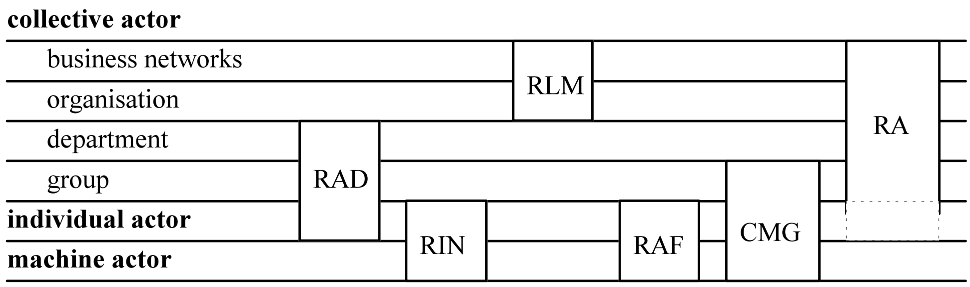

Figure 1. Different definitions of the concept of role

Those approaches which concentrated on higher level roles (RLM and RA) observed the activity without unnecessary details. The situation is, however, also a problem. If the unit of analysis is on a high level (departments, organisations, business networks) the description of the work is lost. For the purposes of IS development this would not be something to seek for. Furthermore, the detailed description has to be produced later in any way. Another problem is that a collective actor can not really take responsibility. It is always the individual who is accountable for something [16].

The approaches with strong emphasis on lower level actors (RAD, RIN, RAF, CMG) describe the activity in great detail. The concept of role seems to serve both responsibility definitions and the description of activity if the units are small enough.

The problems occur when the computer is also taken as a party in the division of labour. By this we do not mean that it is irrelevant to consider which tasks should be supported by an IS. We mean, recalling the act-orientation assumed in the beginning of this paper, that the computer is not qualified as an actor. The computer should not be a party in the collaboration between humans because it can not take any responsibility of the activity. This implies directly that the computer cannot take any role.

In other words, this means that we want to produce a social interpretation of information systems. We therefore require that computer functions have a human actor. In the first place it is the actual user. When the user works by means of the computer, he performs human action. These tasks are treated in the same way as any other tasks; the computer tool does not give them any special status.

We do not accept the mixed human/computer actors, even if we would benefit from the detailed description because we would loose the clear boundaries of responsibility between individuals. We do not assume the notion of collective actors neither, even if we would benefit from having the clear boundaries of responsibilities and specialisation; we do not want to loose the detailed description of activity. We may in our later work construct a concept for the collective role, but now we use the more fundamental one, the role to be taken by individuals.

The very nature of the concept of role is not to be an objective tool which could be observed in practice and used as an unproblematic unit in job design. Not only the boundaries between roles are difficult to distinguish but also the line between a role and its subroles. The picture we get will always be an interpretation of the work.

3. The Act-Oriented Notion of Role

We present our notion of role in three phases. First we define the role as a structural schema and then as a domain of responsibility. In these phases we refer to IS related examples and our case studies by *text in italic style*. Lastly we study co-ordinational relationships between roles.

3.1. A Structural Point of Departure

Our point of departure is a purely structural view on the role. It is seen as a technical building block which is useful in designing flexible forms for organising work. It may be described by means of the following conceptual schema with two many-to-many relationships:

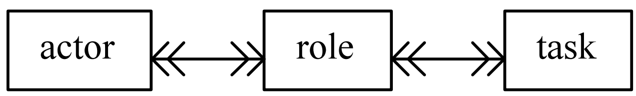

Figure 2. Role seen in connection to the actors and tasks

This schema indicates that a role is a collection of tasks. For example, the role of an inventory man includes all tasks in the inventory. Thus, the role combines the tasks to appropriate units which typically are the smallest units to be used in the division of work, i.e. the roles determine the grain size in organisational co-operation. If, for example, the receiving and the delivery of the goods in the inventory are separated to be performed by specialised groups, the role of inventory man is divided accordingly into two subroles. Then also the granularity is decreased.

A typical example of computer-supported tasks is the list of items in the menu. One item often corresponds to a task and the collection of items on one user's screen determines the role. Tasks for delivering goods from the inventory may be e.g. finding the location of oldest products and the updating of the stock at hand.

Narrow roles with a small set of tasks are likely to imply a fragmented job design. On the other hand, very large roles are obstacles for flexibility in the organisation of work.

A good example of a degraded role was the punched card operators. On the other extreme we still today find examples of generalists in information technology who are supposed to know all about everything, an impossible role.

Often it is practical to let one task belong to several roles. In an office environment, for example, most employees can take photocopies and also actually do it, even if it could be possible to have specialised person(s) for this (sub)task.

Information technology and networking have opened quite new possibilities for both specialised and non-specialised solutions for such tasks which occur frequently and in many places. Many clerks in an insurance company, for example, have to check the credit-worthiness of the customer, even if they are performing tasks which belong to different task chains.

Many employees can work in the same role. This is not only for meeting the adequate work load when one person has insufficient capacity. Shift work, geographical distances and absences can flexibly be dealt with by using multiple role characters. The application of this structural principle adds flexibility by making it easier to find solutions to the equation between the employees' working hours and tasks to be done.

Networking and groupware programs are supporting such sharing of roles. When a bank clerk during low traffic moves from the front-office to the back-office, he takes a new role and opens a new program with different tasks and menus. The change of the offices doesn't have to be physical anymore. It can be done virtually.

In the ETHICS methodology [e.g. 25] the concept of autonomous groups is one form of role sharing. Everyone in a group is able to do all tasks, i.e. there is no formal specialisation within the group and every role is shared.

Roles are not given. Even if the job descriptions would be well documented, the scope of a particular role is always subject to interpretation. Peculiar practices can be found in work places with exceptions and special exceptions of exceptions.

One guideline is that tasks allocated to different roles could (but must not) be performed by different persons.

In an insurance company four persons were calculating premiums for new contracts by means of a special computer program. Three of them also recorded the outcome to the data base, while there was a fifth person assisting the fourth one to store the results. The only explanation we could find was that those three were female and the one was male. In this case, the calculation and the storing belonged to different roles.

In a concrete work situation the actor is not automatically in any role, he must take a role. This is in line with the notion of deliberate action. The actor must be aware of the actual role he is keeping and the role's rules in order to be able to take the responsibility for performing acts according to these rules. In other words, a deliberate actor knows what he is doing.

Logging in to a particular program stands for taking the corresponding role. Performing individual tasks is also rather well distinguishable in computer-supported work.

Of course, there is the responsibility - or accountability - for the rolekeeper to perform the role's tasks well, according to the rules of the organisation and of the profession. There are two kinds of rules: rules between the roles and rules within the roles. The actor must have permission to take a particular role. This is part of decisions and agreements made in the process of organising the work. So is the knowledge about where the tasks come from and how they do it. These are rules between the roles.

The permission to computer-supported roles is typically controlled by means of access privileges. The rolekeeper must, of course, be aware of the work flow and co-ordination with other roles.

The most important prerequisite for such an assignment is that the actor must have the adequate competence for all the tasks included in the role in question. These rules how the tasks are done are internal to the particular roles. In addition, there must be adequate resources available and the right to use them.

It is not enough that the actor is professionally qualified and properly introduced to the organisational culture. In performing computer-supported tasks she has to have adequate resources and sufficient skill and knowledge in IT. Furthermore, she must understand how the tasks of her profession get done by means of this technology.

The multiplicity of the roles is why the role system cannot be changed arbitrarily or abruptly, because the rolekeepers must know both external and internal rules, i.e. they must learn the skill and knowledge needed for the performance of the tasks of the role.

We can also say something about the origin of the rules. They follow the natural patterns of habitualisation and institutionalisation [4]. Rules which have proved purposeful, are applied without questioning them. Breakdowns are likely to lead to new rules. Informal groups use rules which are less objectified than those typical of formal organisational units. Some rules in bureaucracies seem too be reified, i.e. there is no legitimation available in terms of meaningful human activity.

Information systems themselves are collections of rules [26]. Among them are not only the instructions how to use the artefact. The functions are objectifications of rules applied in professional practice. For example, a book-keeping program must follow the laws and other rules of the accounting profession.

3.2. Domain of Responsibility

The structural view on roles may give the impression that the actor is sitting and waiting for a task to arrive. Then she checks whether this task belongs to any of her roles, performs it skilfully and delivers the outcome with the expected reports.

The working life does not, however, follow this fragmentary assembly line metaphor. The instances of tasks are not independent events to be responded by the actor. Time is more continuous than a mere succession of discrete task events. The actor has some domain of responsibility. This domain may contain a concern on space, tools, materials, knowledge, infrastructure.

For computer-supported work, the actor must supervise all exceptions and breakdowns. If the network is not working properly, she has to report it and get it fixed. If she cannot use the program, she has to learn it.

For example, the inventory man is naturally responsible, or even accountable for the products he has received and not yet delivered further. He has to store each item in a reasonable place. He has to find the oldest item of certain product when requested. The responsibility cannot be reduced to discrete events.

In the inventory the responsibility for the material is thus connected to the accountability for the data which describes the state in the inventory, i.e. the domain of responsibility. The actor is not only responsible for correct performance of the transactions. The cumulating result of these transactions; the detailed inventory records must also give a true description of reality, even after exceptions and breakdowns.

Thus we realise that the tasks are interconnected and that they constitute a domain. This domain grows to the basis of high quality work, the starting point to the articulation work. Of course, such a domain may be well or poorly designed. How can we identify a good role and its domain of responsibility?

A good role is probably impossible to define, but it is characterised by a natural set of tasks which belong together and constitute a whole. It includes no unnecessary interruptions in work flow. The outcome has a clear identity which can be easily evaluated.

In information systems we advocate the property of semantic integrity. It suggests that the responsibility for a certain part of the organisational data base (storage) should be given to those roles which are most dependent on the high quality of those data. For example, if the inventory details are in error, the inventory man suffers most and immediately. Thus it belongs to his responsibility domain to maintain high quality in this set of data. This is semantically connected to his responsibility for the products themselves.

If there are more than one person sharing the same role, they must have some rules to maintain their shared responsibility.

In a mass inventory we met a group of seven persons who worked in parallel in the same role. In this case the co-operation was fluent, probably due to the restricted size of the group. The direct social control was sufficient to prevent any opportunistic behaviour.

The domain of responsibility in the group with the same role is not always very large. For example, a pool of supermarket cashiers do have the same role, but their jobs are not intensively co-ordinated beyond the scheduling practices. Slow pace or mistakes made by one clerk is more a matter of the manager than the other clerks. These observe the consequences in the form of longer queues.

On the other hand, the co-ordination around a shared system resource may become problematic, if the number of rolekeepers increases.

A big insurance company paid an extra bonus for every new customer an employee could get. This policy and the information system, which was not too easy to use, caused trouble to their customer database. The same data appeared several times because it was not easy to find out whether a customer was already registered or not. Furthermore, employees were not motivated to search customer data carefully and they got paid for the mistakes. At the same time the overall usability of the computer system reduced radically. In this case the chosen incentive was wrong and the computer system made things even worse.

The definition of the role concept in terms of tasks and domain of responsibility reminds us of the corresponding dichotomy in the General Systems Theory [22], which employs a dual notion with static and dynamic elements (states and state transitions).

In information systems, even development methodologies follow this dichotomy. Structured methodologies with their data-flow diagrams emphasise the processes, the dynamic properties. Data base oriented approaches take the static aspect as the starting point. Object-orientation aims at encapsulating both aspects within single object classes, sacrificing the clarity of the basic duality.

This dual view is biased to the internal rules of the role. The underlying philosophy of information ownership suggests that ' ...every piece of data in an organisation is the responsibility of a specified individual. That data can only be stored, viewed, modified, processed, or deleted with the permission of the owner.' [5, p. 25]

When we put the roles to be parts in a larger system, we find out that we need more intensive forms of co-ordination between the roles. Roles are, after all, vehicles for division of labour, both in analysis and design. Even this fits nicely with the principles of the GST.

3.3. The co-ordination between roles

Every piece of task in a company can be appointed to a role. Several specialised roles create the structure of the division of labour. If there were no specialisation in a company everybody would be doing everything. The more specialised the workers are, the more co-ordination is needed between the work roles.

However, there is no coherent body of theory concerning the co-ordination. In general, the co-ordination is defined as an act of working together and managing interdependencies between activities [e.g. 17]. According to Crowston [7] most researchers assume that when the dependency increases, more powerful co-ordination mechanisms are used. At the same time it means that the communication between units, the need for making decisions, the unexpected situations and the cost of co-ordination increase, too [30]. Another solution would be to try to reduce the dependency between units [7, 24].

The dependency is created in advance during the role design. It belongs to the set of external rules. The GST metaphor works here as well. If we regard the role as a subsystem, it should have boundaries which are crossed relatively seldom, i.e. work within a role is more intensive than co-ordination with other roles. Furthermore, it is an advantage if also co-ordination is based on institutionalised rules; then the parties know where, when and how co-ordination is supposed to take place.

It is a topic of another paper to present a taxonomy of different types of co-ordination. These are numerous. It can be some material thing arriving and telling by its mere existence: "please do the usual tricks to me!" Or it may be a report of working hours to be sent to the payroll. We have successfully applied two general principles in the analysis of co-ordination.

Question 1 is, what the actor must know in order to get his task done. How does he know that there is a task to be done? How does he identify the task type and articulate an appropriate performance strategy? Where is the object of work and how can he get it to his work space? Which ordinary and which tailored rules of working apply for this particular case? Following the life cycle of a task from the initiation to the termination with this question in mind is a useful technique for raising many usually invisible aspects of co-ordination to the surface.

This question has its symmetrical counterpart as well: what do people in other roles need to know about this actor's activity? There is, of course the delivering of the deliverables and reporting at the end of the task. But there are also other needs to inform other roles: about the domain of responsibility, e.g. the progress of work or about the objects of accountability.

Question 2 utilises old wisdoms of the GST. Co-ordination between two roles can be effectively analysed by asking what is that unit which these two roles form together. This setting distinguishes the mutual co-ordination from the co-ordination which each of them has with third parties. The real strength, however, lies in the fact that the mutual co-ordination becomes visible. It is likely that some non-productive co-ordinating tasks could be eliminated if a joint role is applied [18].

Information systems have many faces in this co-ordination. It may provide the very object of work, e.g. a document to be edited. Or there are data which belong to the domain of responsibility with the right and duty to update them. Or there are messages to trigger, modify, control or report the rolekeeper's activity. Such co-ordination needs can often successfully be implemented by means of shared data storages and access privileges to them. Any piece of program which reads or modifies these data must be consequently subject to corresponding access restrictions.

In the inventory, the inventory men had the exclusive right and duty to determine the allocation of the products and the amount in the storage, because it completed the responsibility they had for the goods themselves. They were not, however, allowed to add new product ids or delete old ones, because this was obviously the task of some other role in the production planning. On the other hand, the accountability implied that the inventory men were allowed to update their inventory data only through official transactions, not for fun or for stealing products. Exceptions (e.g. disposals) had to be confirmed by an impartial manager with sufficient rights.

Shared data bases can be interpreted as archives, but the reading and writing privileges make them also to vehicles for communication (from the writer to the reader). This can be well utilised in communication between roles. We remember that the inventory man should be prepared to inform salesmen and other interested parties about the availability of different products. This could easily be implemented by giving the salesman the read access to that part of the data base in the inventory man's responsibility domain which tells the amounts in stock instead of sending a message to the salesmen after each modification, or (equivalently) updating the salesmen's data base. The suggested solution has the obvious elegance that it does not violate the domains of responsibility of any role. In addition, it simulates the alternative practice in which the salesman calls and asks the stock at hand. The communication here is not sender-initiated but receiver-initiated.

4. Future work

In this paper we have demonstrated how the concept of role can serve the analysis of ISs. We used the act-oriented view interpreting the system functions as human acts. We also defined that the roles can be taken only by individuals, not by computer systems or by collective actors. These decisions make our notion of role exceptional to those which are used generally in the IS development field.

We found three important aspects of the role: the structural view, the domain of responsibility and the co-ordination mechanisms. The first two dimensions can be distinguished clearly, the third one is actually penetrated into the first two ones.

We also described the links between computer systems and work roles, or rather we de-integrated the system to be embedded in work roles.

Our act-oriented approach extends the possibility to apply the role based analysis of activity in novel and promising ways. Firstly, it can be used in the evaluation of existing systems. Unlike popular quantitative approaches which measure the success of IS as utilisation focused questions [e.g. 13, 31] or as a fit between tasks and technology [e.g. 12, 13] we provide a qualitative evaluation approach in which the technology is embedded in work activity. We have seen that qualitative analysis can reveal, not only the hidden success or failure of the system but also the actual problems and potential solutions of them. Secondly, the specifications and plans of new ISs can also be tested with it. This kind of evaluations are rarely done in practice [20] and they have been seen as the weakest part of professional systems development [1]. Lastly, our role-based approach can be integrated to a system development methodology. Such a methodology gives a stronger emphasis to work and its organisation than most present alternatives. It probably is also usable for redesign. In such context we see the role analysis as a division of labour game that has much in common with organisational design games of Ehn & Sjögren [8].

Our future work, the collective dimensions of the role should be constructed. Organisational units, like profit centres and autonomous groups do "perform tasks" and "have a domain of responsibility", but in a different meaning than for individuals. That difference should be explored and exploited. In other words, we are going to compare collective concepts like organisational memory and organisational learning to the concepts of roles, responsibility and competence.

Another interpretation of roles comes from a top down approach. In a single person's company no specialisation is needed. When a stepwise division of labour is introduced, the co-ordination is emerging in visible terms. Alternatives can be compared with each other. Such comparisons are likely to give criteria to good roles vs. bad roles.

References

[1] C. Avgerou, “Evaluating Information Systems by Consultation and Negotiation,” *International Journal of Information Management*, vol. 15, no. 6, pp. 427-436, 1995.

[2] L.J. Bannon, “From Human Factors to Human Actors: The Role of Psychology and Human-Computer Interaction Studies in System Design,” in Greenbaum J, Kyng M. (eds.) *Design at Work: Cooperative Design of Computer Systems*. New Jersey: Lawrence Erlbaum Associates, 1991.

[3] R. Baskerville and S. Smithson, “Information technology and new organizational forms: choosing chaos over panaceas,” *European Journal of Information Systems*, vol. 4, 66-73, 1995.

[4] P.L. Berger and T. Luckmann, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge.* Penguin Books, Harmondsworth, 1966.

[5] W. Caelli, D. Longley and M. Shain, *Informations security for managers*. New York: Stockton Press, 1989.

[6] P. Checkland, *Systems Thinking, Systems Practice*. Chichester: John Wiley & Sons, 1981.

[7] K. Crowston, “Taxonomy of Organizational Dependencies and Coordination Mechanisms,” *MIT working papers, no*. 174, MIT Centre for Coordination Science, 1994.

[8] P. Ehn and D. Sjögren, "From System Descriptions to Scripts for Action," in Greenbaum, J. & Kyng, M. (eds) *Design at Work: Cooperative Design of Computer Systems*. New Jersey: Lawrence Erlbaum Associates, Ind., Publishers, 1991.

[9] C. Ellis and J. Wainer, "A Conceptual Model of Groupware," *CSCW 1994 Proceedings*, pp. 79-88, 1994.

[10] I.V. Eriksson and M.I. Nurminen, "Doing by Learning: Embedded Application Systems," *Journal of Organizational Computing*, 1(4), pp. 323-339, 1991.

[11] C. Floyd, "Outline of a Paradigm Change in Software Engineering," in Bjerknes, G. Ehn, P. & Kyng, M. (eds.) *Computers and Democracy*, Aldershot: Avebury, pp. 191-210, 1987.

[12] D.L. Goodhue, "IS Attitudes: Toward Theoretical and Definition Clarity," *DataBase*, vol. 19, no. 3/4, pp. 6-15, 1988.

[13] D.L. Goodhue and R.L. Thompson, "Task-Technology Fit and Individual Performance," *MIS Quarterly*, June 1995, pp. 213-236, 1995.

[14] M. Hammer and J. Champy, *Reengineering the corporation: A Manifesto for Business Revolution.* New York: HarperCollins Publishers, 1993.

[15] T. Huckvale and M. Ould, "Process Modelling: Why, What and How," in Spurr K., Layzell P., Jennison, L. & Richards, N. (eds.) *Software Assistance for Business Re-Engineering*, Chichester: John Wiley & Sons, 1994.

[16] E. Jaques, "In Praise of Hierarchy," *Harward Business Review*, January-February, pp. 127-133, 1990.

[17] Y. Jayachandra, *Re-Engineering the Networked Enterprise*. New York: McGraw-Hill, Inc, 1994.

[18] P. Järvinen, "On structuring problems of job design met in the development and maintenance of information systems," *BIT*, No 20, pp. 15-24, 1980.

[19] A. Kambil and J.E. Short, "Electronic Integration and Business Network Redesign: A Roles-Linkage Perspective," *Journal of MIS*, vol. 10, no. 4, pp. 59-83, 1994.

[20] K. Kumar, "Post Implementation Evaluation of Computer-Based Information Systems: Current Practices," *Communication of the ACM*, vol. 33, no. 2, pp. 203-212, 1990.

[21] T. Käkölä, "Increasing the Interpretive Flexibility of Information Systems Through Embedded Application Systems," *Accting., Mgmt. & Info. Tech.*, vol. 5, no. 1, pp. 79-102, 1995.

[22] O. Lange, *Wholes and Parts.* Warsaw: Pergamon Press-PWN, 1965.

[23] H.C. Lucas Jr and J. Baroudi, "The Role of Information Technology in Organization Design," *Journal of Management Information Systems*, vol. 10, no. 4, pp. 9-23, 1994.

[24] J.I. McCann and D.L. Ferry, "An approach for assessing and managing inter-unit interdependence," *Academy of Management Review*, 4(1), pp. 113-119, 1979.

[25] E. Mumford, *Designing Human Systems for New Technology: The ETHICS Method*. Manchester: Manchester Business School, 1983.

[26] M.I. Nurminen, *People or Computers: Three Ways of Looking at Information Systems.* Lund, Sweden: Studentlitterature & Chartwell-Bratt, 1988.

[27] M.I. Nurminen and U. Forsman, "Reversed Quality Life Cycle Model," In Bradley, G. E. & Hendrick, H. W. (eds.) *Human Factors in Organizational Design and Management - IV*, North-Holland, pp. 393-398, 1994.

[28] H. Oberquelle, "Role/Function/Action-Nets as a Visual Language for Cooperative Modelling," *IFIP International Workshop on Human Factors of Information Systems Analysisi and Design*, London, July 28-29, 1988.

[29] G.L. Rein, *Organization Design Viewed as a Group Process Using Coordination Technology*. Report no. CT-039-92, Microelectronics and Computer Technology Corporation, Austin, Texas, 1992.

[30] J.D. Thompson, *Organizations in Action: Social Science Bases of Administrative Theory*. New York: McGraw-Hill, 1967.

[31] R.L. Thompson, C.A. Higgins and J.M. Howell, "Towards a Conceptual Model of Utilization," *MIS Quarterly*, vol. 15, no. 1, pp. 125-143, 1991.

[32] B. Wilson, *Systems: concepts, methodologies, and applications*. 2nd ed., Chichester: John Wiley & Sons, 1990.

[33] M.C. Winte, D.H. Borwn and P.B. Checkland "A role for soft systems methodology in information systems development," *Eur. J. Inf. Systs.*, vol. 4, pp. 130-142, 1995.