

ASAMBLEA ANUAL DE CLADEA 2006
Groupe Sup de Co Montpellier
Montpellier, Francia

América Latina y Unión Europea:
Oportunidades y Desafíos

IV COLOQUIO PREDOCTORAL

ORGANIZADORES : UNIVERSIDAD ESAN
UNIVERSIDAD DE CHILE

Information Systems Development Project as Action Research : Changing a School

by

Carlos Chiu Fu,
Ph. D. Candidate

Doctorado en Administración y Dirección de Empresas
ESADE, España / Universidad ESAN, Perú

Advisors:
Kety Jaúregui, Ph.D., Universidad ESAN
Alfons Sauquet, Ph.D., ESADE

Information Systems Development Project as Action Research : Changing a School

1.- Introduction

1.1 Research objectives

Information System Development Projects are usually carried out using the strategy of divide and conquer, in that way the project is split into two realms, the technical one and the organizational one. This separation institute a division of labor between those people who build the system and those who used it. The literature in both areas, technical and organizational uses this approach either implicitly or explicitly. There have been cases in which this approach leads to success, but there were also plenty of cases in which failures occurred, and the literature point to a culprit which can be called the interface between the technical and the organizational part. According to DeMarco and Lister (1987), "For the overwhelming majority of the bankrupt projects we studied, *there was not a single technological issue to explain the failure*" (p. 4).

The first objective is to study the organizational learning taking place during the lifecycle of an Information System Development project.

The second objective is to make an inquire about the separation between the technical and organizational part of an Information System Development Project, and then find out what is happening in the technical development and in the organizational development.

The third objective is to find out how is the process of the Information System Development when the technical and the organizational development are concurrently implemented during the life cycle of the project.

1.2 Importance of the research

When building an IS, the importance of design has been more significant as time goes, as there is a growing need of designing right in the first place and not when the users complain about the system, and also due to the fact that the technology is developing tools that will enable a mechanical conversion of design into code.(Frankel, 2003). This trend has also increased the importance of modeling, not only in the technical area, which had already a long tradition, but also in the business side, using models which were more formal than simple block and box diagrams (Eriksson & Penker, 2000)

The traditional ISD has been permeate through the duality between developers and users. The development has move from this paradigm through a 'user-centered' paradigm in which the users where studied from the outside, towards a 'user-involved' paradigm in which the users are designers as well.

This change in paradigm express itself also in the changing duality between technological development and organizational change. The traditional point of view was the separation between these two groups due to the different backgrounds that were needed during the development of a "system". Even that the word "system" is usually employed the development of a "system" followed a path which was against its own meaning, that is split it in two parts which are supposed to be independent one to the other.

One reason on the chasm between these two Weltanschauung rests on the fact that organizational studies inherent the traditions of the social sciences, while the technical studies inherent the traditions of science and engineering . Their methods look the same problem from different angles but they don't talk between them; as a result the findings of the organizational studies are of no use for building the systems, and on the other side the system may be build without knowing the context in which they will be used and they may be useless. What is needed is a bridge which can make a continuous contribution starting from the organizational problem and finishing with the product build, implemented and used by the organization.

On the economic side a report by the consulting firm IDC shows that the IT spending in year 2005 will be of 417 bln \$. It is clear that not all this amount of money is being invested in software but it shows the magnitude of the investments in the sector. There has been in the last years a growing interest in using the internet in the schools. Reports from many countries show that teachers, principals, and officials are very positive about the vision of the Internet as a teaching tool, but the reality has shown that the internet is mostly used to access information. Its potential as a innovative learning tool remains unrealized.(Gibson &Oberg, 2004). Nevertheless there has been some experiences reported in which the use of the Internet go beyond the traditional information download (Wallin , 2004),(Smith, Campbell, Hoopingarner, 2004)

2.- The Framework

2.1 Definitions

Some concepts used are almost unanimously accepted, others are subject to different definitions, therefore it is necessary to make clear the definitions we will be using as well as the differences that exist when using a given word which is interpreted by different theories. Insofar *Software* is the set of instructions that makes the computer operate in specific ways. *Project* is a temporary endeavor undertaken to create a unique product or service. *Information system* is a whole formed by people and information technology (process, data, models, applications, machines) working towards some organizational purpose or function. *Information system development (ISD)* can be defined as a change process taken by a development group to achieve certain objectives using Information Systems. *Information system development project* is a temporary ISD

2.2 Theoretical Basis

When analyzing the lifecycle of an ISD it is possible to see three different stages which corresponds to three different goals:

- 1.- Try to decide how to the Information Technology can produce a change in an organization. When the desired change is clear then the goal can be stated as what should be developed.
- 2.- Developing and implementing the software solution. The goal is to develop a technical solution(software).
- 3.- Obtaining the desired change with the use of the developed software

These three stages have different knowledge requirements for the people working on them. When trying to decide what should be done, people have to know about the way they are working, their culture, their values, their fears, their goals (both, open

and hidden),etc. and to lesser degree about technology. When developing the software the knowledge about technology (hardware, software and developing processes) are more important, and when obtaining the desired change it is necessary to know how men and machine work together. This is shown in Fig.1

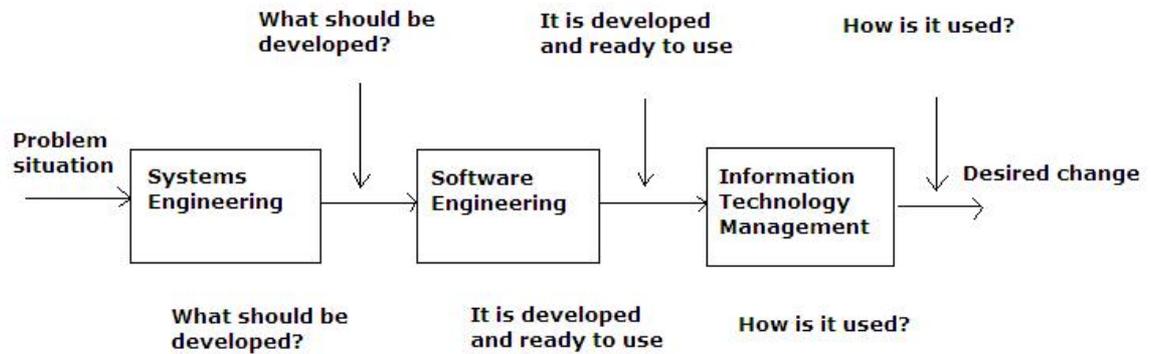


Fig.1 A clean Information System Development

The reality is more complex as these three stages may show. For instance a change may be decided and the corresponding software developed, but then it can be found that the software is not exactly what they had in mind when they thought about the change. That is known in the software engineering praxis as “Changing Requirements”. This is shown in Fig. 2.

There is no a single theory which in a unique way deals with the concrete situation of an ISD Project and as a matter of fact the epistemological explanations of a project change from the very subjective perceptions of what is needed to the very objective goal of running a program.

Therefore the present work stands upon three pillars:

Soft Systems Methodology (SSM) (Checkland ,1999, Checkland and Scholes 1990, Checkland and Holwell 1998)

Agile Methodologies/Extreme Programming (AM/XP) (Beck 2000, Beck and Fowler 2001, Wake 2002, Cockburn 2002, Schwaber and Beedle 2002)

Activity Theory (AT) (Blackler 2003, Blackler,Crump and McDonald 1999, Engeström 1999, Engeström 2001,Collins,Shukla and Redmiles 2002,Tikhomirov 1999, Kutti 1996, Kuutti 1999)

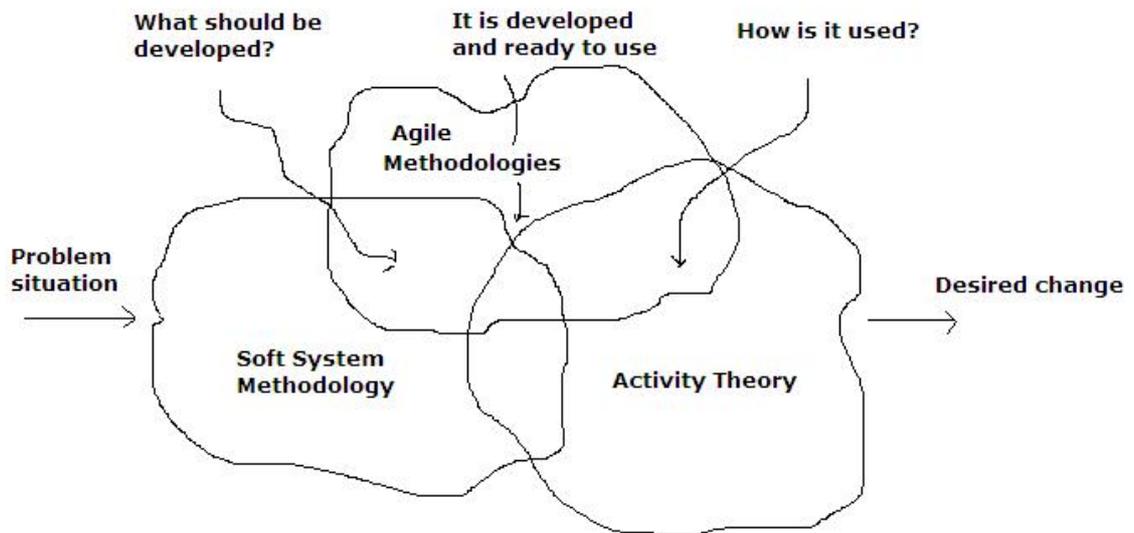


Fig.2 A Fuzzy Information System Development

These theories are used in different parts of the ISD Project, because each of them have an special set of assumptions in which they apply. At the beginning of a ISD project, the specifications of the system , both the organizational and the technical part are not defined, and sometimes the situation seems to be very confusing. In that case the SSM is used to convert the problematic and chaotic situation into a situation which is more orderly and in which it is possible to think in the development of a software solution to the problem. Once the problem has been more or less defined, the main concern is a technical one and the AM/XP methodologies are used. And finally when the software tool is build and deployed the problem shift to the intermediation of the software tool between the users and the people on which the system is used, and that is where the Activity Theory comes.

Why this situation comes into being? . There are several reasons but the main reason is that learning is taking place during the ISD. People think that the problem situation can be solved by a software with a given specification, which can be true for some situations and not so in another situation; or people have a software which is supposed to produce a given change in the workplace, that can also be true or not so; that means that we have a clean ISD when we “know exactly” how our outcome will be, and we know how people is going to react to a given input; when we do not have this, then we will have a fuzzy situation which requires new ways of inquiring into the ISD process.

2.3 The model

Standard theories of learning are focused on processes where a subject (traditionally an individual, in our context also an organization) acquires some identifiable knowledge or skills in such a way that a corresponding, relatively lasting change in the behavior of the subject may be observed. It is a self-evident presupposition that the knowledge or skill to be acquired is itself stable and reasonably well defined. There is a competent ‘teacher’ who knows what is to be learned, a well defined matter which is to be studied, and a well defined goal with given objectives that is to be reached.

When studying ISD there are situations in which this basic assumption works, and when a standard solution is used, it usually works, as many clean ISD projects. These are the traditional training courses which are given to users of a new system in

order to “learn to use the system”. The problem is that there are many cases in which the goal of the ISD is not clear, either in the technical scope nor in the social implications on the work or in both. In that case the development process makes that the learning that happens in this process violates the basic presupposition in which the standard theories of learning are based. That is people and the organization have to learn something that is not stable, not even defined or understood ahead of time.

An ISD Project can be seen as an organizational learning process, and as such there is a model of learning such as Fig.3 shows. This model is a dynamic one because it is a repetitive process which end when the problem situation is solved, and shares some similitude with learning models used in Action Research projects, specially the learning cycle of Soft Systems Methodology.

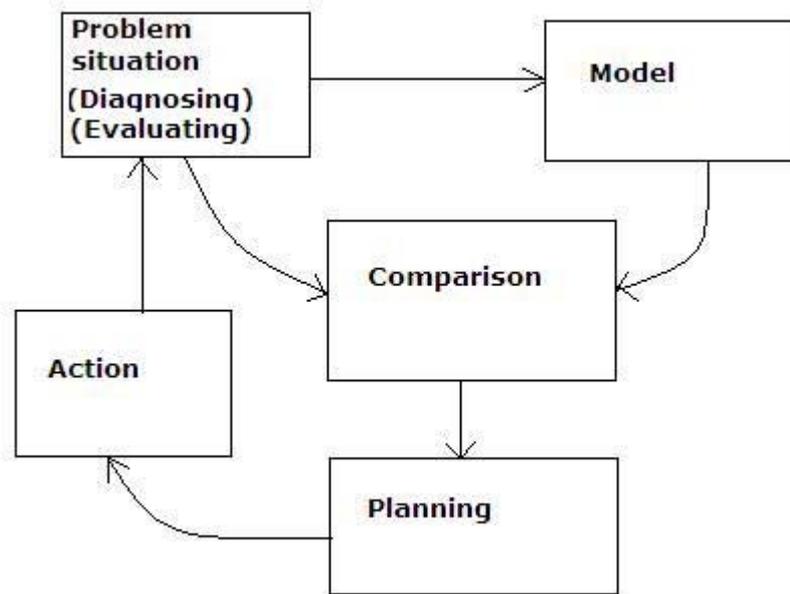


Fig. 3 Learning model

When IS are developed, modified and implemented in an organization, the dual nature of technological and social change is exposed, but not necessarily well understood. A framework is proposed that takes in account this two elements. The first dimension proposed is the Information Technology Development which is concerned with the intensity of the development, mainly of software. The second orthogonal dimension of analysis proposed is the learning that happen in the organization where the IS is going to be implemented. Each of the proposed dimension of analysis consists of a continuum of defining characteristics. This framework gives a more static view of where is the learning happening.

The framework proposed is not restrictive to the number of organizations that participate in the project, there can be a case in which one organization that develops

in-house the software and makes the implementation for themselves, or there can be one external organization that develops the software and implements in the host organization, or even a more complex situation is possible in which an organization develops the software, the second makes consulting on the implementation and the third one is the host organization.

The framework is not also restrictive with respect to the roles that define the relation between developers and user. Current ISD Project Management practice makes a separation between the users that give the requirements for the system and the developers that acquire the requirements in order to build the system. The separation between users and developers can become a one-way transfer of information, that is from users to developers, this mechanism can find several obstacles that impedes learning and progress. A two way information flow can improve this situation, but the current Project Management practice don't advise that because the users can change the requirements on the fly and that can delay the end of the project. On the other side a one-way communication may lead to a project ended on time and budget but that not deliver what the users need. The framework takes in account if there is little communications between these two groups or the project is run as a community effort. What the framework tries to depict is the learning that happens in the host organization.

The dimension of the Information Technology development is the perception of the difficulty in development the software for the participants in the project, and as such is relative. (Boehm et al. 2000, Boehm and Turner 2003) For example an organization that wants to make an in-house development and doesn't have experience in web-technologies may considered the creation of a portal as a technological challenge, but if they find a provider whose expertise is in portals, the implementation of it can be almost a routine task.

As a dimension of complexity of the development, there can be projects with very few people but complex and there can also be projects with a larger number of people that are nevertheless simple.

Change in the organizational learning refers to the deep and intensity of learning that the organization requires to successfully implement the project. (Bateson 1977, Argyris and Schön 1996) The different types of intensity are a continuous one but it doesn't exist a quantitative parameter that can measure it.

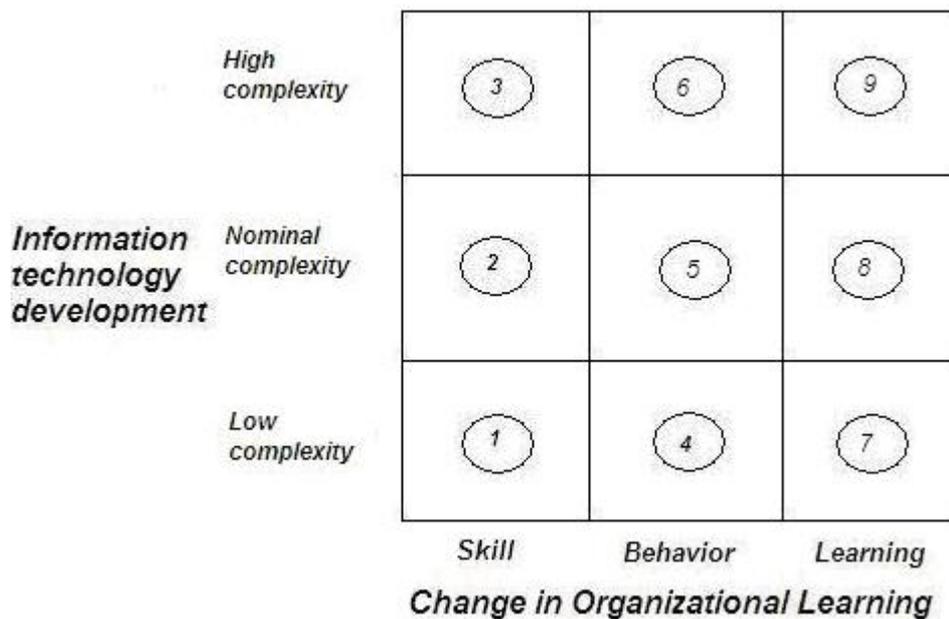


Fig.3 The framework

3.- Research questions:

In order to situate the research a framework for the intervention is proposed. This framework look at the perception of the software complexity of the project and the organizational learning needed as an art of static location on where the learning is happening, and at the same time look at the learning process as an art of dynamic view of how is the learning taking place.

Using these elements, the main research question is posed.

How is the learning process in an organization during the implementation of an ISD project ?

The main research question leads to several sub questions:

To what extent does the static model of software complexity/organizational learning provide a comprehensive framework for understanding and explaining the learning process happening during an ISD project?

What are the ways that the organizational learning affects the software development ?

What are the ways in which the new developed software affects the organization?

To what extent does the proposed model help the design of the information system.?

The unit of analysis in the research is the ISD project. The goal of this thesis is to make a methodological contribution to the ISD which takes in account the social,

cultural and technical aspects of the problem and is also goal oriented in the sense that a given objective must be reached in order to claim success.

I use the action research methodology as an enquiry mechanism to address the different issues associated with the ISD Project. (Avison and Taylor 1977, Baskerville and Wood-harper 1996, Baskerville 1999, Argyris and Schön 1996, Mumford 2001, Myers)

4.- The project:

In the last years several private schools were created, who offered the similar features of the school. The introduction of Internet access, was a trigger for soul-searching in the school who decided to look for its roots and make a transformation of the teaching, moving from the traditional teaching to a new one which should use the modern technology but integrated to the way of teaching and learning in the school. It was intended to create a "The School way of teaching".

Before the start of the project the school direction made a diagnosis of the school situation where they found the following problems

Teaching

- The teaching was the traditional sort (Chalk and Blackboard), where the teacher speaks to the students and they should listen to them and learn.
- There was a tendency of learn by memory, and some test asked some memoirist facts
- They used a textbook so they endorsed almost blindly the contents of the textbook, and there were very few critical thought on the themes treated by the authors of the textbooks.
- The teachers had a very limited knowledge of computer technology, which as a rule was smaller than most students had.

Assumptions in which the traditional teaching happened

- Information scarcity in which it is assumed that teachers have more information available as their students.
- Local scope in which it is assumed that the students when they leave the school will live, study and work in the region or country
- The banking concept of education in which the teacher owns the knowledge which is given to the students. The teacher is a "bank" of knowledge.
- Explicit knowledge which is transmitted from the textbooks with the intermediation of the teachers.
- The relation between teacher and student is such that the teacher teach and the student learn, the situation in which teacher and student learn together is seen as a lack of knowledge by the teacher
- Parents don't teach in which it is assumed that the parents leave their children in the hands of the teacher, and that they don't have a responsibility on learning outside the control of the homework.

Failure of past experiences

There were successfully experiences which were abandoned with the time, producing a loss of organizational knowledge. As learning methodology the school used:

- Group dynamic to foster team work.

- Self made learning material.
- Use of computers as a learning tools (Programming and Simulations).
- Use of the internet as a medium of contact with students of other countries.

From these four past success only the first one is still used. The production of the learning material was given up because no organization was set up to store (digital) and manage the material and also because teachers push for the use of textbooks. There were also a question of cost. The use of computers as learning tools was given up because the teachers didn't interiorize the use of the tool. The students who made the experience had more knowledge than the teachers and could use the simulators better than the teacher which could result in a loss of face.

Starting of the project

The school has around 40 teachers, and a group of eight were selected which represented different classes (From 2nd year primary school to 5th year secondary), and courses (Mathematics, Natural Sciences, Language and Primary School Teachers). They were chosen on the basis that the School Principal considered them to be the people that could adapt at most to an organizational change. The School Principal was also part of the Team.

The first meetings concentrated on making sense of the actual situation and the main research technique was the workshop in which the learning aspects of the project were given in order to deal with the SSM work methodology, the need of an open discussion among the stakeholders and the need to overcome the defensive reasoning in the members of the team. The technique of "left-hand column tool" (Argyris and Schön 1996) was used in order to explain the team members the difference between the theories in use and the espoused theories in the school, as well as the implicit defensive reasoning that lays deeply in all individuals. In order to have a minimum common knowledge in order to start the action research project five workshops were given in which the methodology of SSM was described as well as the use of systems theory in order to have an holistic view of the situation.

The other important issue was the collection of qualitative data, being the most accurate the video or sound recording followed by an interpretive study, but this method strong conflicted with the cultural and conjuntural situation of the country, because it didn't allow an open discussion and critique of the school, therefore a notes taking approach was followed in order to note the observations on the team.

Five relevant systems were discussed:

1. Team working in class
2. Relationship Teacher-Student
3. Relationship School-Parents
4. Methodology and course materials
5. Knowledge sharing among teachers

The first relevant system to be analyzed was Team Working in class, it was supposed that the problem situation should have been converted in a well-defined problem before the other relevant systems were addressed, but the action research showed that the other relevant systems were interwoven among them, so that a parallel analysis of the other four were also started. Each session took around 2 hours of

discussion and the results were posted in form of a small report with the conclusions of the discussion. Action Research requires the active collaboration between the researcher and the team members and heavily depends on the willingness of the stakeholders to enter into an open discussion. Cultural problems arise when trying to implement the SSM, the first one is the fact that the Peruvian culture is very authoritarian, and therefore there is a tendency to avoid criticism specially in front of the authority and the second is the concept of agreement for the members of the team, which lead to delays in the implementation of many actions.(Hoftstede 1984)

In order to test some educational ideas an open source e-learning system was installed in the school intranet and e-mail accounts were given to the teachers and pupils of some classes. The teachers were asked to put their courses plans in the intranet and some of them have begun putting their classes contents in it. At the present time the teachers have still problems getting use to the tool and only one teacher in the group is posting her classes and making use of the internet.

5.- Conclusion

Even though it is an ongoing project , the research has shown several findings:

SSM takes in account the cultural aspects specially when discussing the changes that will be implemented, nevertheless some cultural assumption are implicitly taken specially on regard to the perceived situation of the problem definition. SSM and Action Research require an open discussion and negotiation of an agreement between the stakeholders, these characteristics are typical from the anglo-saxon cultures but not from latin ones, specially the Peruvian.

When the technology is introduced in a place in which the stakeholders don't know a priori the consequences of the innovation, the learning process is not limited neither to the learning of technology or to organizational change, but also a learning on their core knowledge such as communications, writing, and teaching. Learning the technology poses less difficulties as the learning of the core knowledges for teachers, specially due to the high risk of losing face in front of the society.

References

- Argyris C & Schön D.(1996) *Organizational Learning II*- Addison-Wesley Co.
- Avison D. & Taylor V (1977) Information Systems Development methodologies: a classification according to problem situation. *Journal of Information Technology* 12, (pp.73-81)
- Baskerville R. & Wood-Harper A.(1996) A critical perspective on action research as a method for information system research. *Journal of Information Technology* 11. (pp235-246)
- Baskerville R. (1999) Investigating Information Systems with Action Research, *Communications of the Association for Information Systems* (2:19)
- Bateson G. (1972) *Steps to the Ecology of Mind* ,New York: Ballantine Books
- Beck K. (2000) *Extreme Programming Explained*,Addison Wesley
- Beck K. & Fowler M. (2001) *Planning Extreme Programming*, Addison Wesley
- Blackler F.,Crump N. and McDonald S. (1999) Managing Experts and Competing through Innovation: *Organization* , Vol 6(1) (pp. 5-31).
- Blackler F. (2003) An Activity Theoretical Perspective on Workplace Learning - *Notes for the Seminar on "Workplace Learning and Intervention"* Copenhagen

- Boehm B.,Horowitz E.,Madachy R.,Reifer D.,Bradford K.,Steece B., et al, (2000) *Software Cost Estimation with COCOMO II*, Prentice Hall
- Boehm B. & Turner R. (2003) *Balancing Agility and Discipline : A Guide for the Perplexed* Addison Wesley
- Checkland P.B. (1999) *Systems Thinking, System Practice : Includes a 30 year retrospective*, New York: Plenum
- Checkland P.B. & Scholes J. (1990) *SSM in Action*, Chichester: Wiley
- Checkland P.B. & Hollwell S. (1998) *Information, Systems and Information Systems*, Chichester: Wiley
- Cockburn A. (2002) *Agile Software Development*, : Addison Wesley
- Collins P., Shukla S. & Redmiles D. (2002) Activity Theory and Systems Design: A View from the Trenches. *Computer Supported Cooperative Work: The Journal of Collaborative Computing* 11(1-2) (pp 55-80)
- DeMarco Tom, & Lister T. (1987) *Peopleware : Productive Projects and Teams*. New York : Dorset House Publishing Co.
- Engeström Y. (1999) Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Engeström Y. ,Miettinen R. and Punamäki R.(Ed). *Perspectives on Activity Theory* (pp. 377-406).Cambridge: Cambridge University Press
- Engeström Y. (2001) Expansive Learning at Work: Toward an Activity Theoretical Conceptualization *Journal of Education and Work* 14(1) pp. (133-157)
- Eriksson H. & Penker M. (2000) *Business Modeling with UML* - New York : OMG Press, John Wiley
- Frankel D.S.(2003) *Model Driven Architecture*. Indianapolis: OMG Press, Wiley Publishing
- Gibson S. Oberg D. (2004) Visions and Realities of Internet Use in schools: Canadian perspective - *British Journal of Educational Technology*- Vol 35 Nro 5 (pp 569-585)
- Hofstede, G. (1984). Culture's Consequences: International Differences in Work-Related Values. Beverly Hills: Sage.
- Kuutti K. (1996) Activity Theory as a Potential for Human-Computer Interaction Research. In Nardi B. (ed) *Context and Consciousness: Activity Theory and Human-Computer Interaction*. Cambridge MA : MIT Press
- Kuutti K. (1999) Activity theory, transformation of work and information systems design. In Engeström Y. ,Miettinen R. and Punamäki R.(Ed). *Perspectives on Activity Theory* (pp. 360-376).Cambridge: Cambridge University Press
- Mumford E. (2001) Action Research: Helping Organizations to Change. In Trauth E. *Qualitative Research in IS: Issues and Trends*, Hershey PA, Idea Group
- Myers M. Qualitative Research in Information Systems , References on Action Research <http://www.qual.auckland.ac.nz>
- Schwaber K. & Beedle M. (2002), *Agile Software Development with Scrum*, Prentice Hall
- Smith, W.S., Campbell M.E.,Hoopingarner A.L.(2004), Science Activities, *Spring, Vol. 41 Issue 1*, p9-15.
- Tikhomirov O. (1999) The theory of activity changed by information technology. In Engeström Y. ,Miettinen R. and Punamäki R.(Ed). *Perspectives on Activity Theory* (pp. 347-359).Cambridge: Cambridge University Press
- Wake W.(2002), *Extreme Programming Explored*, Addison-Wesley
- Wallin-Oittinen T.(2004), Finnish Comprehensive School Students Contemplate the Forest Fires of Indonesia 1997 from Internet and Newspaper Reports - *International Research in Geographical and Environmental Education - Vol 13, No2*, - pp 143-150