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People and Computers:
Twenty-one Ways of Looking at Information Systems

Timo Järvi and Pekka Reijonen (Editors)

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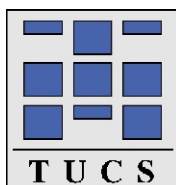# Twenty-one Ways of Looking at Information Systems

Timo Järvi and Pekka Reijonen (Editors)

For Professor Markku I. Nurminen on his 60th Birthday, June 11, 2003.

TUCS

Designing Information Systems for eBusiness Networks:
The Return of Productivity Paradox

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Abstract. In this paper we discuss productivity paradox and the origin of business value of ICT investments, especially as we see that the present approaches in building ICT-based value networks of companies raises new productivity problems. The findings indicate that the organizations can reap the benefits of ICT-investments in terms of productivity only by managing the long term process change both at operational and management levels to match the organizational capacity and competitive position. This is achieved not by building information systems only, but by balancing automational, informational and transformational effects in the business context. We analyze three alternative approaches for information systems development against this backdrop: software engineering, business process redesign and reversed quality life cycle (RQLC by Nurminen & Forsman, 1994). There is growing evidence in favor of RQLC in designing and implementing intra-organizational systems, so we apply its ideas in the design of inter-organizational information systems (IOSs). In the inter-organizational context the importance of building of trust, creating standards, and need for openness for new type of business partners will become vital in controlling the number of relationships and adaptation processes. Finally, building on the ideas above we synthesize a model for building an inter-organizational information systems ecology.

1 Introduction

It is generally believed that organizations may make their operations more efficient with information and communication technology (ICT). However, for example productivity effects of ICT have been difficult to establish, and in practice ICT systems have been found quite difficult to accomplish successfully, especially complicated it seems to be within inter-organizational environments (Morrel & Ezingeard, 2002). In this paper we present a complementary explanation on what is a very profound reason for our profession not being capable of designing successful ICT-systems in a constant manner. The explanation is based on Nurminen's and

Forsman's (1994) Reversed Quality Life Cycle –idea pointing out the importance of learning from experiences of actual work and new practices, and reflecting these upon the design of the computerized systems.

First, we will discuss productivity paradox and the origin of business value of ICT investments. Then we describe three alternative approaches for creating this business value and expand our discussion to inter-organizational setting. It seems that organizations can reap the benefits of ICT-investments in terms of productivity only by managing the long term process change at operational and management levels to match the organizational capacity and competitive position. Since this is quite a tedious process, we cannot but predict a rather pessimistic scenario of the future of developing systems for a set of inter-related organizations, probably exceeding the severity of the former productivity paradox.

1.1 Productivity paradox

Despite the fact that information technology has attracted the majority of investment funds during the last years it is clear that the number of people working for the ICT is growing, so is the sheer number of data processing and transferring capacity. However, the effects of these investments are regularly under heavy speculation: in the nineties there was a lively discussion on the so-called productivity paradox, initiated by a Nobel Memorial Prize Laureate Robert M. Solow ("*we see the computers everywhere but in the economic statistics*"). Recently, the discussion has been on the burst of the recent techno bubble.

In their extensive study on the lacking productivity improvement of the information technology investments, Brynjolfsson and Yang (1996) induce that there are four possible reasons for the productivity paradox:

1. Mismeasurement of outputs and inputs, i.e., the researchers have not been able to identify proper measures and indices to reveal the true value of ICT-investments; for example the change may be qualitative in nature, so that official productivity statistics do not notice any change.
2. Lags due to learning and adjustment, which means that the pay-off period may be much longer than expected, after all, and realize only after a significant time lag.
3. Redistribution and dissipation of profits, i.e., the investors (or other parties) benefit at the expense of other parties, thus leveling out the productivity growth at an aggregate level. In a similar manner, the pioneer investors may not be able to reap the profit as they have to pay steep price to the technology developers.
4. Mismanagement of information and technology, which means that companies are misallocating their funds, timing the investments poorly, or not able to improve the productivity but rather creating slack (excessive resources).

Later, Brynjolfsson and Hitt (2002) present evidence that computerization really contributes to productivity of firms in long term[1], and that those investments have provided excess returns. They suggest that computers are part of a larger system of technological and organizational change that increases firm-level productivity over time (i.e., there is the time lag). They conslude also that computers are 'general purpose technology' whose primary contribution is to make new production methods possible when combined with "*large and small complementary changes, including changes in business processes, organization structure and innovations in customer and supplier relations*" (i.e., there is an evident need for the management of the technology implementation in the organizational context) (Brynjolfsson & Hitt, 2002, p.2).

This has been further evidenced by contemporary researchers at more micro-level: evidently this transformation process takes time and the results can be seen only after considerable time has passed from introduction of the new system - after the information system has been adapted to the actual use context and vice versa. In reality the causal chain seems to be such a complex one that it cannot be examined with simple correlation tests. Therefore meaningful investigation of this phenomenon and also development methods of new information systems requires perspectives of both technology and organizations, and their interaction (Mooney, Gurbaxani and Kraemer, 1995).

1.2   The origins of business value

Mooney et al. (1995) propose, building on Zuboff (1988), that IT can have three separate but complementary effects on business processes. First, *automational effects* refer to the role of IT as a capital asset being substituted for labor. Within this dimension, value is obtained primarily from impacts such as productivity improvements, labor savings and cost reductions associated with operational processes. Second, *informational effects* emerge primarily from IT's capacity to process information to help decision making, coordination, communication and control processes (Mooney et al. calls them management processes). The value accrues from improved decision quality, employee empowerment, decreased use of resources, enhanced organizational effectiveness, and better quality. Third, *transformational effects* refer to IT's ability to facilitate and support process innovation and transformation. Within this last dimension the business value comes in form of reduced cycle times, improved responsiveness, downsizing, and service and product enhancement as a result of redesigned processes and organizational structures. The source of higher orders of value is the extension of the automational effects of IT to management processes, and the extension of informational effects to operational processes. Figure 1 below provides an illustration of dimensions of IT Business value by Mooney et al. (1995). It should be noted that the realization of

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[1] In firm level analysis using five to seven year differences.

potential benefits requires that also development funds should be allocated accordingly (Reijonen & Heikkilä, 1999; Heikkilä, Saarinen & Sääksjärvi, 1991).
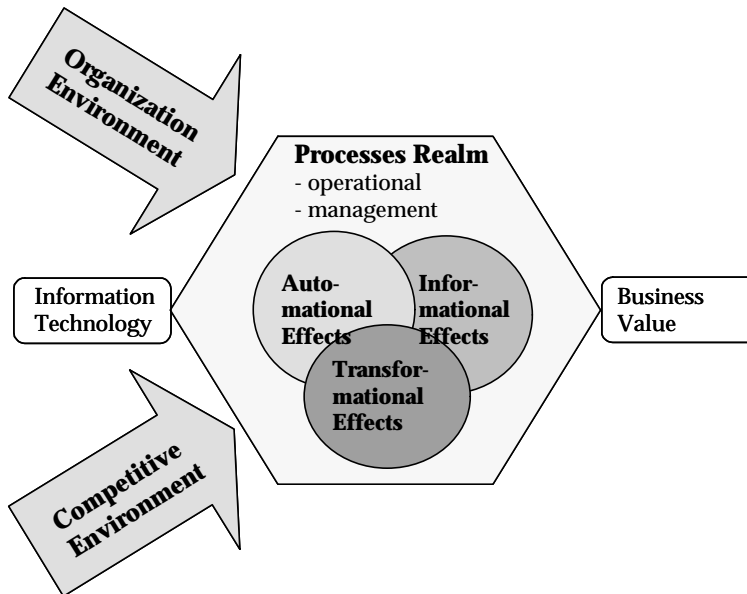

Figure 1. Dimensions of IT Business value by Mooney et al. (1995).

To summarize, it seems that organizations can reap the benefits of ICT-investments in terms of productivity by managing the long term process change at operational and management levels to match the organizational capacity and competitive position. However, although we know the panacea, there are still many companies that are not still able to do that (e.g., Paper, Tingley & Mok, 2003; Larsen & Myers, 1997; Sarker & lee, 1998).

2   Approaches to designing IS for an organization

The field of IS, and especially IS-design has traditionally had an objectivist approach to technology: By presuming that technology is an object capable of affecting social systems, such research treats both technology and organization as objects (Orlikowski & Robey, 1991). This approach is challenged by a rich line of literature highlighting the importance of interplay between technical and organizational changes where investments in IT can be seen complementary to various organizational measures (Zuboff, 1988; Nurminen & Forsman, 1994; Robey & Sahay, 1996; Orlikowski, 1996; Reijonen & Heikkilä, 1999). They propose that organizational context influences the consequences of information technology

(Zuboff, 1988) and they also support an incremental, continuous vision of technical and organizational change (Robey & Sahay, 1996; Orlikowski, 1996). Coarsely speaking – these ideas correspond with the need of management of the technology assimilation in its context. In the productivity paradox this is negatively defined as one of the causes – mismanagement of information and technology.

An additional viewpoint to this is the social construction of technology (Bijker, 1987): Information technology in general belongs to the set of learning-intensive technologies requiring substantial adaptive learning (Curley & Pyburn, 1982; Heikkilä, 1995). "*This adaptive learning is argued to require both the training and iterative ongoing learning in the use context, where training, goal-setting, and feedback evaluation alternate*" (Heikkilä, 1995, p. 16). When the emphasis is shifted from the development to the use or exploitation phase of an IS, we can also view the whole process of applying ICT as a learning process. This learning process for the use of an information system in real terms is often a tedious and long-lasting journey (Heikkilä et al, 2003). There are multiple parties and actors with differing views and needs, and various interactions with other work tasks or activities, especially when we are taking about inter-organizational IS. Furthermore, as Leavitt (1965) points out, an organization consists of at least four variables: structure (the boundaries, administration and functioning of an organization), task, people and technology. These variables are highly independent, so that a change in one variable most often results in an intended or unintended change in other variables as well, which in turn cause new changes in the system. Against this backdrop it is evident that this transformation process takes and will always take time. To our understanding this is a feasible explanation to the time lag, which was another cause of the productivity paradox by Brynjolfsson & Yang (1996).

How well do then, the prevailing schools of thought in IS design take these two major factors in explaining productivity paradox into account? We distinguished three approaches to information, communication and technology development in the organizational context: *Software engineering*, *BPR*, and *Reversed Quality Life Cycle*. We shall next describe briefly what we mean by these approaches.

2.1   Software Engineering – constructing technical system first

The software engineering approach to ICT development was introduced in the very beginning of the computer system era (Nurminen & Forsman, 1994). In this technology oriented approach, the methods and models, such as traditional life cycle, were applied to reduce the complexity of the development of information systems by cutting the project to distinctive, controllable phases. In software engineering the unit of analysis is an existing function, and the goal is to automate the operations.

In brief, the life cycle goes as follows (see also Figure 2 for the effort curve): First, the specifications of the technical system are defined systemically in detailed level. Then the technical system is programmed to meet these requirements, so the better you define it the better it will serve the final purpose. Finally, the system is

put in use, and the development shifts to a maintenance phase. Most effort is spent during the design and development, the major concern being to spend enough resources in the requirements specification in order to avoid undesirable recursive loops back to the higher abstraction levels. The objective is to make a complete system that is quick and easy to implement. If there happens to be an organizational mismatch, it can be sorted out by change management.
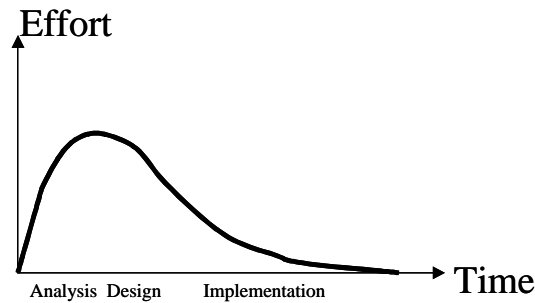

Figure 2. The effort curve for Software Engineering Process.

Software engineering is the prevailing mainstream approach, the growth of which has been boosted by the trend to outsource. This simply because of the fact that the object to be created must be fully specified in advance to avoid possible ex-post contractual disagreements.

2.2   Business Process Redesign – streamlining business first

In the 90's the IS literature started to suggest that business value is attainable only when the business processes are re-engineered prior to the application of IT (Mooney et al, 1995). Instead of functional improvement, process innovations were sought for achieving dramatic improvements in critical measures of performance (Hammer & Champy, 1993; Davenport, 1993). Previously the business processes hardly were designed taking into consideration the capabilities of IT (Mooney et al, 1995). Most traditional applications of IT were designed to automate existing functions and thus missed the real potential of computer technology to support entirely new models of how work is performed. The rationale for process re-engineering was typically to improve financial performance, most often by cost reduction. Other process-based objectives, including time reduction, improved quality, improved customer service, are assumed to result in higher levels of sales or reduced cost of production (Mooney et al, 1995).

Basically, what BPR-advocates do, they change the order of IS-design activities the other way round and put more emphasis on the business needs of the customers as the starting point for the design (see Figure 3. for the effort curve). The motto is: the simpler the better. Some studies have been able to show, that actually more emphasis should be put on the latter, implementation stages of the BPR process

than originally suggested (e.g., Sarker & Lee, 1998), and that still there is a lot of unanticipated contingencies to be expected in the due course (e.g., Larsen & Myers, 1997).
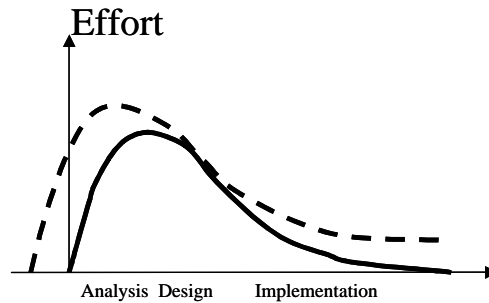

Figure 3. The effort curve for a BPR Process (marked with a dotted line) vs. Software engineering approach.

Because of the heavy burden of redesigning of business activities, the popularity of BPR has been probably less than expected. But it is still the way to approach especially inter-organizational systems (see e.g., industry-wide initiatives such as Collaborative Planning, Forecasting and Replenishment *www.cpfr.org*, RosettaNet or similar integrated systems, Kopanaki & Smithson, 2003) in order to harmonize and simplify interfacing processes.

2.3 Reversed Quality Life Cycle – change the focus to human behavior

Markku I. Nurminen and Ulf Forsman (1994) questioned the separability postulate widely applied in the traditional information system literature. Their message was that an ISD project could not be separated from the activity it is intended to support (see also the division in socio-technical design, e.g, Mumford & Beekman, 1995). According to Nurminen and Forsman the intention of the development activity is to create a system that is to be exploited in a certain context, the emphasis should be put on the use phase of the lice cycle, instead of the development of the computerized artefact. Similarly, instead of product oriented quality of the software, we should evaluate the systems based on their exploitability in their use context.

Their suggestion was that "*the traditional life cycle model should be reversed so that the analysis would start in the last phases of the IS*" (p. 396). Then the most significant part of the process would be the use period of the system, which time to time might be interrupted by maintenance and development phases.

The reversed quality life cycle model thus '*expands the unit of analysis from a single IS to the entire work activity of the actors*'. In this view the actual software development phase is only a short period in the continuum of work activity. This

view has also obvious implications also in the resourcing of the development activity: the phases before and after the 'actual software development' should be taken seriously and resourced adequately (see Figure 4).
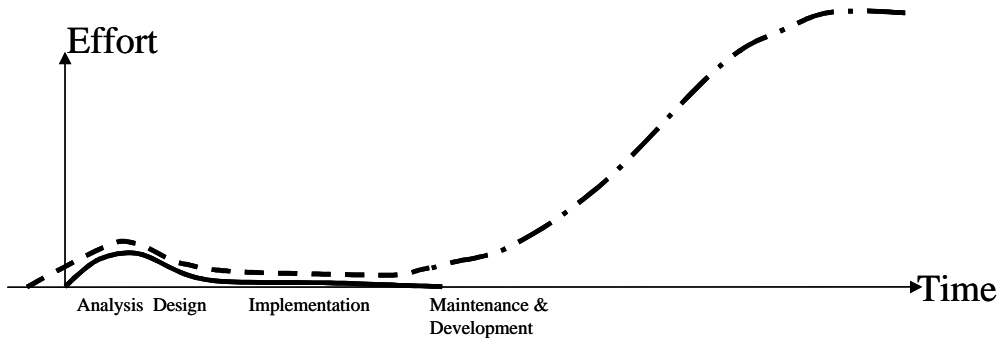

Figure 4. The effort curve for Reversed Quality Life Cycle approach (marked with dotted line) vs. Software Engineering approach.

It is interesting to note that Nurminen & Forsman have heavy support from the organization change literature: Beer et al.'s (1990) described in their series of studies how to revitalize (i.e. to introduce permanent improvement) to an existing company's activities. Their results are well in line with recent studies on business process development (e.g. Sarker & Lee, 1998). First, the intentional change (in Table 1 called 'Intervention') should start from modifying informal behavior at the level of official social unit. This is to utilize the social coherence in order to achieve real change in the roles, responsibilities and relationships of the people. Only then should we start coaching, training, etc. at the individual level and make sure that the momentum remains by creating vision of the roles of the people in the near and long term future. It is also important to award good performance. Only in the last stage – after the social organization is more-or-less stable- is the time to introduce the formal systems (Beer et al., 1990). However, this does not exclude the development of the information system parallel to the organizational development, what Nurminen and Forsman actually suggest.

Let us contrast the above reasoning with the rational, process based design of IS: It supposes that the strategic IS planning (including investment payoff calculations etc.) and systems design have been carried out properly, and the aim of the software engineering, also BPR is simple: To line out how, and by whom, the work tasks are carried out using the new system, and to train the actors these new standard procedures. This is actually just the opposite from the solution observed and suggested by Nurminen & Forsman (1994), or Beer et al. (1990), who emphasize the importance of designing the intervention, aiming at changing informal behavior, before or in parallel with the design of formal systems.

Table 1. The order of changing activities in an organization (adopted from Beer et al., 1990.).

<div align="center">Level of Focus</div>

Intervention seeks to modify	Unit level	Individual or group level
Informal behavior	Redefinition of - roles - responsibilities - relationships *(1)*	Coaching/Counseling Training Process consultation Team building *(2)*
Formal design	Compensation systems Information systems Organizational structure Measurement system *(4)*	Replacement Recruitment Career pathing Succession planning Performance appraisal *(3)*

To summarize, we can draw further conclusions – in order to reap productivity benefits, an organization should change first the behavior of the people to the new activities supported with the IS. The IS is to be designed in parallel with the development of the activities, in order to get sustainable changes in the activities. Unfortunately, this is laborious, and it will get even more burdensome when we start designing systems for inter-organizational use.

3   Designing IS for networks of organizations

In business networks there are multiple independent, but interrelated parties. Thus, it is typical for such a network to consist of multiple sets of organizational values, cultures, standards and IT architectures. Also their *production typologies*[2] differ, hindering the implementation of uniform processes. As van de Ven indicates (already in 1976), the companies are looking for complementary resources from other companies, but as they do not know each other too well, building the trust and knowledge upon each others is a crucial adaptation process: "*The emergence and functioning of an IR (inter-organizational relationship), therefore, is a cyclical process of: need for resources – issue commitments – inter-agency communications to spread awareness and consensus – resource transactions – and structural adaptation and pattern maintenance over time*" (Van de Ven, 1976, p. 33).

Mooney et al. (1995) pointed out the three differing means for how IT may affect business process, and suggested that the most powerful effects are gained when these effects are mixed and applied to both operational and management processes. This clear picture becomes more complex, however, when we think

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[2] i.e. Engineer-to-order, Assembly-to-order, make-to-order, make-to-stock, or a hybrid of the previous.

about the business process as a business value chain crossing firm boundaries (see figure 5.). Then the business value is a joint product of multiple companies benefiting from the automational, informational, and transformational effects. We should take into account all the three effect levels within the separate company but also within the networked organizations, and in the dyadic relationships between the co-operating companies. This soon increases the number of relationships beyond reasonable limits[3]. To benefit from the network, we should be prepared to meet the implementation success factors in each party and relationship. In other words, we should apply the implementation approach first within each individual company (marked with 1 in Figure 5), then in each dyadic relationship (marked with 2), and finally at the level of the whole network (marked with 3).
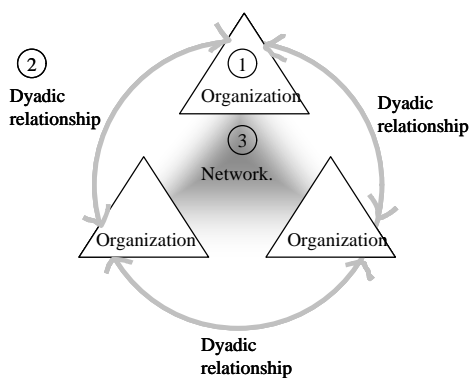

Figure 5. A simplified presentation of relationships within a network.

Now, when organizations are forming networks and are considering to use ICT to assist cooperation, it would be essential to learn from previous experiences and to apply the 'right' development approach from the beginning. Unfortunately, it seems that the present approach of introducing systems to a network of companies is unfruitful from this perspective (see e.g., Kopanaki and Smithson's analysis on the strategic, structural, and operational level effects of an Continuouous Replenishent System from different participant perspectives, 2003).

In line with the Reversed Quality Life Cycle there will be a multitude of simultaneous change processes within each organization. If we take seriously the lessons from earlier BPR-studies, organizational change studies, and Nurminen's & Forsman's reasoning for dismissing separability of technology and activities, and turning around the idea of engineering life-cycle, we soon realize the overwhelming effort needed in building inter-organizational systems for, say, electronic commerce

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[3] Notice, that as the number of participants is increased to n+1, the number of dyadic relationships between the companies is increased by n. Thus, for instance in a development of an IT system for network of three companies we should study carefully the network constellation, three separate organizations, and three different dyadic relationships, altogether 7 points. When the size of the network grows to four, the respective number of study point increases to 11.

(see e.g., the constant revision of ISS needed by Dell Computer, Kraemer et al., 2000).

Against this backdrop, we anticipate three issues necessary for re-thinking the development of information systems for the networks of companies:

First, there is a growing need of *building trust* between companies by mutual adaptation and learning – ultimately, the companies are participating in order to attain their self-interest objectives (Van de Ven, 1976; Nurminen & Forsman, 1994; Andersen & Christensen, 2000). This will emphasize the importance of reversing the life-cycle: instead of building the information system in the first place that cement the operations and structures (Kopanaki & Smithson, 2003) a period of mutual adaptation and groping is necessary to define the objectives, roles, similarities and differences between companies for the common good (Andersen & Christensen, 2000). The role of trust is emphasized when there are power and size asymmetries between the companies participating to the network (Hackbarth & Kettinger, 1997; Morrell & Ezingeard, 2002). Information systems are a vital, inseparable part (Nurminen & Forsman, 1994) of this process of searching for core competences and co-operative capabilities.
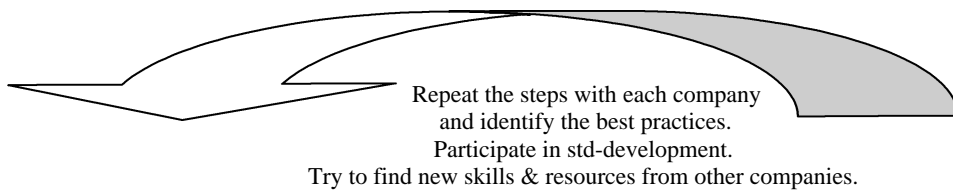
Second, the first trend emphasizes *quest for standardization*: There will be a myriad of open, national, and international standards around that can serve the purpose of simplifying the interfacing of different systems. Instead of trying to integrate seamlessly anything, somewhat satisfactory standards are needed to meet the most basic needs of the business transactions at the three types of relationships.

Third, there is a *need for new intermediaries*. Van de Ven (1976) claims that the organizations are pushed into inter-organizational relationships, because of either they are having an internal need for resources or they are committed to an external problem or opportunity in the overlapping domains of organizations. Let it be either of the reasons, the company is facing a need for new resources in form of personnel, information, monetary or physical resources, or access to clients or markets etc. (Van deVen, 1976). These resources may be found from the traditional partners (overlapping domains), but it is most likely that, the companies *must also be open to new intermediaries* in the similar manner than in finance sector. These companies are providing value-added info-mediary type of services (consultancy, research, data warehousing, etc.) to the networks of companies by taking advantage of the increased amount of excessive information and consequent asymmetries between parties. In essence this would mean more middlemen taking over some of the complexities and information overload of the companies (see e.g., Wise & Morrison, 2000). From the design point of view, this would underline the importance of building relationships with the emerging companies and institutions beyond the original value creating system of the companies. To our mind also this emphasizes the idea of reversed life cycle.

As suggested by Nurminen & Forsman (1994) the behavioral changes in each company should meet the real life performance criteria by improving the efficiency of the total "*Information Systems Ecology*" (ibid. p. 398). They state that "*The Information System Life Cycle has a meaningful existence only embedded in the Business Life Cycle*" and that "*The Business Life Cycle is here understood as the intellectual and practical manifestation of a given business idea of a given corporation, which encapsulates among other things the exploitation of IS, Life Cycle of the corporation in all its aspects*". To put it simply, the problem domain and information system serving it form a unity, they are not separate from each other, as suggested by software engineering, or BPR-approaches.

Hence, in the spirit of Nurminen's and Forsman's (1994) information systems ecology, we suggest the expansion of Reversed Quality Life Cycle to cover the simultaneous development of business activities, information systems, organizational capabilities, and trust in developing inter-organizational information systems. More specifically, we propose the necessary steps for creating an information systems ecology for business networks (see Figure 6, which is a synthesis based on Heikkilä et al., 2003 and the ideas of reverse life cycle and inseparability of ICT from its use context by Nurminen & Forsman, 1994):

1. When developing an ICT system for networked organization, the process should start with definition of objectives and targets for the future processes (note: not the ICT system) taking into consideration the needs within the organization, within all dyadic relationships the organization is involved and within the network itself. This should be done together with the management of the company – as they are best aware of the strategic and operational objectives of the company, and to ensure the commitment of the management for the project. However, simultaneously with the above, we should find out how the users work now and use this information as a starting point for improving the process. In this way, we should be able to ensure that the objectives are in line with good process design.

2. The second step is to start developing versions of ICT solutions for prototyping purposes. Again, simultaneously we should let the users to develop practices, generalize roles and rules, and align ICT accordingly. This is at the core of reverse life-cycle idea (Nurminen & Forsman, 1994)

3. The above-mentioned steps should be repeated in each participating organization. In the inter-organizational level design of information systems the seamless integration of all the systems should not be the primary objective. Instead, we should identify the best practices, and aim at developing standards for interfacing the systems between the participants to control the number of relationships and adaptation processes. Furthermore, we should try to find ways to transact new resources and interchange skills between the companies (Andersen & Christensen, 2000).

Repeat the steps with each company
and identify the best practices.
Participate in std-development.
Try to find new skills & resources from other companies.

STEP 1.

What: Define the objectives and targets for the future processes within the organization, in dyadic relationships, and within the network.
Who: with the management of the networked companies.
Why: in order to meet the operational and strategic objectives.

STEP 2.

Start developing versions of IT solutions for prototyping purposes.

——— Simultaneously ———   ——— Simultaneously ———

What: Find out how the users work now and use this information as a starting point for improving the processes.
Who: with the users.
Why: for achieving the objectives in line with good process design.

Let the users develop practices, generalize roles and rules and align IT accordingly.

Figure 6. Developing Information Systems Ecology for networked organizations (based on Heikkilä et al., 2003).

4 Conclusion

We are confirmed that designing IOSs as part of the business redesign and change processes remains a major headache for IS-managers, management and personnel of the companies in the Western economies for the foreseeable future. As Nurminen and Forsman (1994) point out in intra-organizational setting, it is a necessity to join technical, human and business perspectives in development of ICT solutions. Unfortunately, our greatest concern is that building complex *inter-organizational* systems in an outsourced and subcontracted environment is such a technical challenge that it will draw the attention away from the seminal issue of reversing the life cycle for developing more efficient operations pinpointed by Nurminen and Forsman (1994). This will be especially true in the present outsourced, subcontracted information systems development practice. We suspect that this may easily lead to strategically dysfunctional armchair business models, phenomenal misplaced investments, huge implementation problems and severe organizational clashes, as illustrated in some recent studies (Paper et al., 2003). This will inevitably lead to high failure rates, and reincarnate the notorious productivity paradox. In the worst case we shall see longer than expected lags and mismanagement of the technology, unless the lessons from organizational

development, reversed quality life-cycle, and business process redesign are not taken seriously into account in the inter-organizational setting.

Therefore, we suggest an expansion of the Revised Quality Life Cycle approach (Nurminen & Forsman, 1994) for developing inter-organizational information systems. This means that the objectives and targets for the future processes should be considered within three levels in all the participating companies: within the companies, their dyadic relationships, and the network. This is important in creating trust and commitment between the participants that, in essence, are taking part in the co-operation due to self-interested reasons (in an intra-organizational setting trust was not a major issue). Simultaneously it should be ensured that the objectives are in line with good process design and that they are feasible, by starting the analysis by gaining understanding on the users and the management's actual work behavior. The second step is to start prototyping ICT solutions and let the users to develop practices, generalize roles and rules, and align ICT accordingly.

On the level of the network we should not try to integrate seamlessly all the systems of the companies into one mutual system. This is because there are so many relationships, consequent adaptation processes, which may not be compatible due to various operational, structural, strategic, or even institutional reasons. Instead, we should identify the best practices, and aim at developing standards for interfacing the systems between the participants. Furthermore, as the organizations incentive to take part in a network is to find additional funds, physical assets, personnel, information, access to clients or markets etc. (Van de Ven, 1976), emphasis should be put on acquisition and sharing of suitable resources in the sense of information systems ecology for improved productivity (in the sense of Nurminen & Forsman, 1994). These new value-adding resources may also be found outside the current network, such as intermediaries providing info-mediary type of services.

Our Life Cycle for developing ICT in networks builds on the idea proposed by Nurminen and Forsman (1994) that ICT solutions are inseparable from the use context, and built only after there is an emerging change in the behavior of the workers towards new practices (Beer et al., 1990). Instead of building the information system cementing the operations and structures (Kopanaki & Smithson, 2003), a period of mutual adaptation is necessary to define the roles, similarities and differences between companies for the common good and trusted relationships (Andersen & Christensen, 2000). Additionally, we point out the need for creation of standards, which simplify the interfacing of different systems within the network. Thus, instead of trying to integrate seamlessly the systems, somewhat satisfactory standards are used to meet the most basic needs of the business transactions. Finally, the companies should be prepared to build relationships with the emerging companies and institutions beyond the original value creating system towards information systems ecology.

Acknowledgements

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