
Collaborative Implementation of Inter-organizational Interoperability in a Complex Setting

N.N.^{a,1} and N.N.^b

^aM.M.

^bM.M.

Abstract. This paper explores the challenges in the collaborative implementation of inter-organizational interoperability through observations of social dynamics. We focus on an inter-organizational information system that has interfaces with several information systems managed by different organizations. This complexity increases degrees of difficulty of the implementation projects. Our main finding is that as the inter-organizational nature of the problem increases considerably the technical complexity of the implementation, it also significantly increases difficulties in the social dynamics. We argue that a careful analysis of these social issues can reveal some interesting viewpoints that otherwise may stay hidden. We limit this paper to consider only the implementation of an inter-organizational information system that is implemented to support pre-defined joint functionalities.

Keywords. Interoperability, implementation, inter-organizational information system, collaboration, social dynamics

1 Introduction

Inter-organizational information systems are implemented because they inevitably increase the possibilities of organizations to collaborate with each other [7, 15, 26]. Inter-organizational information systems allow, for example, enterprises to participate in the e-economy by enabling cross-organizational connections in a network or supply chain. Information system implementations are described challenging efforts that require expertise, insights and skills of several individuals [23]. Information technology has enabled ever quicker information sharing and transfer across organizational borders and this has come true because modern technology enables interaction without physical attendance. By saying this, we want to emphasize the increased interaction among people in organizations but also between organizations. However, implementing collaboration technology in inter-organizational settings may cause additional complexity compared to intra-organizational implementations [18].

¹ Corresponding Author, Email:

Enterprises and other organizations have acknowledged the benefits gained from collaboration and joint ventures. The increasing attention of interoperability issues in information systems was noted in 1995 when Manola introduced his study on interoperability in large-scale distributed object systems [16]. His focus is on enterprise-wide client-server systems that are developed to support operational computing. Furthermore, Southon *et al.* [22] note that especially participating organizations with a degree of autonomy have much to gain from cooperation.

In this paper, we explore, from the social dynamics point of view, the issues that are to be faced as organizations build a joint information system. Especially, we try to give some in-depth insights to the challenges of that task. Our research methods were case study and participatory observation. The study material was gathered from a single case where several organizations from academia implemented an information system to support their mutual collaboration. Despite academic background of the research material we believe that our results are fairly well applicable to situations where enterprises are implementing inter-organizational information systems to support concurrent engineering methods.

One of the researchers participated in the case while collecting the material. She was acting as a project manager and thus she was also able to influence the goings in the implementation project. The research approach was very subjective and the interpretations based mainly on subjective experiences. However, there were several sources used when performing the study and the principles expressed by Klein and Myers acted as a backbone in the research [13].

2 Information System Implementation and Interoperability

Modern technology enables organizations to interact with each other without physical contact or attendance [17]. Close interaction is necessary when enterprises and other organizations collaborate with their partners or with their surrounding society. Inter-organizational information systems are planned to transfer information across organizational borderlines [10]. In recent years inter-organizational information systems have increasingly tended to support partnering among organizations [8] and organizations should link with each other to perform effectively in present-day environments [3].

In this paper, we consider implementation as an entire process from needs analysis and choice of technological solution, to the realization of the full benefits from the technology [18]. Information system implementations are also instances of organizational change ([4, 20]. Organizations and information systems are closely related because there is ever growing interdependence between business strategy and information systems and telecommunications [15]. Any change in this relationship requires changes in other components of the relationship.

In many organizations, information is distributed over several information systems and an exchange of information is often very difficult [6]. This distribution can be described with three layers: 1) business architecture that defines the organizational structure and the workflows for business rules and processes; 2) application architecture that defines the actual implementation of the business concepts coded in the application; and 3) technology architecture that defines the

information and communication infrastructure where information technology tries to meet the business requirements.

The chosen architecture sets requirements also to interoperability. 'Interoperability' is a general concept that has different contents depending on the context it is used. NATO, the US and Australia define: "The ability of systems, units and forces to provide the services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together." [1]. A more common definition states: "the ability of two or more systems or components to exchange information and to use the information that has been exchanged" [9].

Manola notes the importance of interoperability at many different levels *e.g.*, physical level (data presentation) and object-model level (agreements on object interface characteristics) [16]. He extends the need of interoperability to semantic interoperability with agreements on meaning. He concludes that providing interoperability in large-scale business systems can be a long process.

Interoperability is recognized as the most critical issue facing businesses that need to access information from multiple information systems [19]. In their study on facilitating semantic interoperability among distributed and heterogeneous information systems Park and Ram highlight multiple interpretations of data by different users and systems in different contexts.

Klischewski describes how both interoperability and cooperation are needed to enable cross-organizational integration [14]. He argues that there are two prominent concepts pointing to different directions:

- 1) Information integration that aims at facilitating information flow across technical and organizational borders and

- 2) Process integration that focuses on interrelating steps and stages of process performance across technical and organizational borders. Klischewski concludes that it is important to understand three issues:

- 1) Interoperability requires a guiding vision of integration,
- 2) Each type of integration points to a different set of ideas, assumptions and technical means, and
- 3) Integration implies a strategic commitment to explicit forms of cross-organizational cooperation and their implementation before it can be modified into digitized mode.

3 Research Approach

This research was qualitative. Therefore it enables and requires the researchers to explain the research setting in detail enough to help the reader to understand the research approach. When explaining the case the role of interpretation is recognized, paying attention also to the experience that inevitably influences our actions [25]. The means of case study and participatory observation have been chosen due to their convenience in our research.

The use of participatory observation was realized especially when the researcher who acted as a project manager, was not active in the actual development work but observed and made notes while the experts in that area were

working [5, 12]. However, the research approach was not emphasized in the project meetings because the utmost goal from the organizational view was to get the information system implemented.

The research material was collected as memorandums from project meetings and emails from the files of the project manager. Some of the memorandums were written by the project manager, the others by other people who were present in the meetings. The memorandums were accepted according to the protocol in the consequent project meetings and thus they give objective description about the situation. In addition to the official memorandums, the researcher wrote notes from discussions and encounters. There were no tape-recordings because some attendees denied their use in the meetings. This research aims to present the case realistic, pointing critically out some issues that appear problematic [24]. However, the confessional style is present due to the personal research material of the researcher.

Furthermore, the researcher was keeping a personal diary while managing the project and saved her observations there [2, 11, 21]. Interviews were not conducted, because the researcher was acting as a project manager and thus she might have influenced the opinions of the interviewees.

Totally independent source of research material came from the feedback that was voluntarily given by the end-users. At the end of the project altogether 580 feedback notes were sent to the project management.

4 The Case and Findings

The case in our research consists of an information system project where an inter-organizational information system (called I-System in this paper) was designed and implemented to be piloted before taking into nation-wide use.

In the project there were several organizations involved and they had chosen their representatives to participate in the project group. A commercial vendor was hired to implement the system. Due to the inter-organizational nature, the information system was to be implemented among several other information systems. In addition, due to the inter-organizational nature, also the interfaces between the necessary information systems had to be implemented.

The project started its actions in the summer 2003 when the first sketches about the future I-System were drawn on a blackboard. I-System was aimed to support the collaboration between the participating organizations and the information systems owned and managed by the organizations were considered in the very beginning. I-System was to be built on specifications that were made in another project by other stakeholders. Already then there were ideas about having several information systems to be connected with each other. Information would be transferred via utility files. An important risk was recognized: if the necessary connections were implemented one at a time, the interaction between the parties could become problematic. (Memorandum June 16, 2003).

The importance of the new information system was realized by one participant: *“If the information system will not be implemented, the actions will be declined in our organization. The stipulation for the nation-wide actions will be an information system!”* (Memorandum September 12, 2003). The chairman stated in

the same meeting: *“Our motive is to get this information system as soon as possible because it’s impossible to act in the current way.”*

I-System was to have both intra-organizational and inter-organizational interfaces. The intra-organizational interfaces are described in Figure 1.

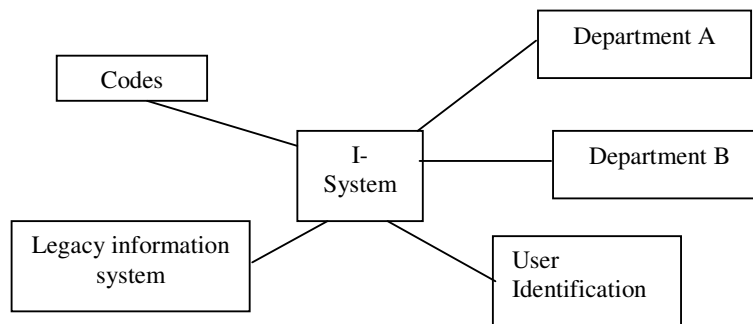


Figure 1. Intra-organizational interfaces

Figure 1 presents I-System connected with several other information systems in the organization. The users must be identified before letting them log into the system. Furthermore, there were several departments in the organizations and they had their own procedures how to act and manage their functionalities. The organizations had their own codes and abbreviations that were found in their database. And further, I-System was connected with the legacy system used in the organization.

Even if the need of several interfaces between information systems was realized in the first meetings, the building of the interfaces was not self-evident. The need to transfer information between information systems was discussed every now and then in the project meetings when the users wanted to have information to be transferred to their main systems. The users got positive response: *“They are planning to make changes that enable external information to be received.”* (Memorandum May 4, 2005). However, the plans were not made concrete in the legacy systems.

On the other hand, it appeared that the legacy systems were not open to let other systems to access them. *“No files may be directly transferred to their servers.”* (Memorandum August 24, 2005). This issue was discussed every now and then in the project. This discussion evolved especially when there were changes in the project personnel. *“We will probably build an interface in the legacy information system to enable automatic data input. In the future the data could be transferred automatically from I-System.”* (Memorandum October 4, 2006). The answer remained the same: *“So far no automatic writing to the receiving systems may be done.”* (Memorandum November 2, 2006).

I-System was planned to support collaboration between the participating organizations and this character necessitated interfaces to be build according to the

organizations. Because the organizations were interdependent and they had their own information systems, the interfaces differed from each other. In the beginning there were only three user organizations participating but the number of them increased smoothly. In addition, in the development work there were other organizations needed that were responsible *e.g.*, some of the legacy systems and data administration. We perceived problems with commitment by some of the organizations, though. The project manager got email (September 16, 2004): *"It really seems that all tasks that were assigned to Acro [pseudonym] are left half-way."* There were problems with the user organizations, too. The project manager got email May 12, 2005: *"The situation is as before. We'll start the technical implementation at the end of the summer."* This email discussion continued on February 10, 2006: *"The progress has been slow. The specifications are almost ready. We'll try to get this fixed in the second quarter."* However, the assignment was not completed until the project was ended.

We also perceived reluctance in delivering information in organizations when there was need to get changes made in other information systems. On several occasions it was found that knowledge was not available there where it was needed. *"I'm sorry about this outburst but we don't really know anything about this task and this 'cgi' is everything we have been told even if we wanted to know something else about it, too!"* (Email August 8, 2005). This problem in interaction was evident *e.g.*, when the interfaces to offer data from a legacy information system were needed. We also noticed that the need was not informed to the actors that were responsible for the new functionality. *"We [project managers] cannot push them to transfer information in their organization. They have been present when we have discussed about transferring data between I-System and their information system."* (A phone call to the project manager from the vendor).

This reluctance also influenced interoperability between organizations because the information needed was not available in I-System that was to use it and to deliver it forward.

5 Conclusions

When analyzing research material we must be conscious of the interpretative nature of the task. In this sense, our personal experience influences also this, however, how objective we try to be in our approach.

We witnessed that high felt motivation from the very beginning was driving the project forward. All the same, motivation perceived by some people is not enough if pertinent people are not motivated. Due to the diversified setting with several actors interoperability was difficult to carry out. In our case, all desirable information was not available when users needed it in the new information system.

Further, we also noticed that not all needed information was forwarded in the organizations especially in case of distributed departments and units. This lack of information sharing inhibited future development and influenced also plans to develop I-System.

On the other hand, a higher level of interoperability was expected from the legacy system's point of view as new people asked for "automatic information

transfer” from I-System. Again, this proposition was an evidence of new needs for close collaboration and interoperability between the information systems. So far no automatic transfer was allowable here but we believe that changes will be made in the near future. Because this specific need was expressed by the master information system, the feature is expected to be implemented before long.

In summary, the main results were: 1) despite the high motivation towards the joint information system there can be a considerable lack of information sharing; 2) during the implementation new expectations of higher interoperability may appear that hinder the progress of the project; 3) difficulties in the social dynamics are increased considerably due to the inter-organizational nature of the setting.

We believe that the issues found in the present study are quite common to all projects that try to implement inter-organizational interoperability. Our findings came from a single case and thus it is quite natural to expect that future work is needed to confirm these results.

7 References

- [1] Clark T, Moon T. Interoperability for Joint and Coalition Operation. Australian Defence Force Journal 2001;151:23-36.
- [2] Coghlan D, Brannick T. Doing action research in your own organization. Sage Publications, London, 2002.
- [3] Daniel EM, White A. The future of inter-organisational system linkages: findings of an international Delphi study. European Journal of Information Systems 2005;14(2):188-203.
- [4] Davis GB, Olson MH. Management information systems: Conceptual foundations, structure and development. McGraw-Hill Book Company, New York, 1985:561-601.
- [5] Flick U. An Introduction to Qualitative Research. Sage Publications Inc., Thousand Oaks, 1999.
- [6] Hasselbring W. Information system integration, Communications of the ACM 2000;43(6):32-38.
- [7] Hevner AR, March ST, Park J, Ram S. Design Science in Information Systems Research. MIS Quarterly 2004;28(1):75-105.
- [8] Hong IB, A new framework for interorganisational systems based on the linkage of participants’ roles. Information & Management 2002;39:261-270.
- [9] IEEE. IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries. Institute of Electrical and Electronics Engineers, New York, 1990.
- [10] Johnston HR, Vitale MR. Creating Competitive Advantage with Interorganizational Information Systems. MIS Quarterly 1988;12 (2):153-165.
- [11] Kemmis S. Exploring the Relevance of Critical Theory for Action Research: Emancipatory Action Research in the Footsteps of Jurgen Habermas. In: Reason P, Bradbury H (eds) Handbook of Action Research. SAGE Publications, London, 2002; 91-102.
- [12] Kemmis S, McTaggart R. Participatory action research. In: Denzin NK, Lincoln YS (eds) Handbook of Qualitative Research. Sage Publications Inc., Thousand Oaks, 2000; 567-605.
- [13] Klein K, Myers M. A set of principles for conducting and evaluating interpretative field studies in information systems. MIS Quarterly 1999;23(1):67-94.

- [14] Klischewski R. Information Integration or Process Integration? How to Achieve Interoperability in Administration, 2004. Available at: http://is.guc.edu.eg/uploads/egov2004_klischewski.pdf. Access on: Nov. 15, 2006.
- [15] Laudon KC, Laudon JP. Management Information Systems, New Approaches to Organization and Technology. Prentice-Hall, New Jersey, 1998.
- [16] Manola F. Interoperability issues in Large-Scale Distributed Object Systems. ACM Computing Surveys 1995;27(2):268-270.
- [17] Markus ML. Building successful interorganizational systems. In: Chen C-S, Filipe J, Secura I, Cordeiro J (eds) Enterprise Information Systems VII, Springer, Heidelberg, 2006.
- [18] Munkvold BE. Challenges of IT implementation for supporting collaboration in distributed organizations. European Journal of Information Systems 1999;8:260-272.
- [19] Park J, Ram S. Information Systems Interoperability: What Lies Beneath? ACM Transactions on Information Systems 2004;22(4):595-632.
- [20] Sawyer S, Southwick R. Temporal Issues in Information and Communication Technology-Enabled Organizational Change: Evidence From an Enterprise Systems Implementation. The Information Society 2002;18:263-280.
- [21] Schultze U. A Confessional Account of an Ethnography About Knowledge Work. MIS Quarterly 2000;24(1):3-41.
- [22] Southon G, Sauer C, Dampney CNG. Lessons from a failed information systems initiative: issues for complex organizations. International Journal of Medical Informatics 1999;55:33-46.
- [23] Tiwana A, McLean ER. Expertise Integration and Creativity in Information Systems Development. Journal of Management Information Systems 2005;22(1):13-43.
- [24] Van Maanen J. Tales of the Field: On Writing Ethnography. University of Chicago Press, Chicago, 1988.
- [25] Walsham G. Interpretive case studies in IS research: nature and method. European Journal of Information Systems 1995;4:74-81.
- [26] Wognum PM, Mensink G, Bühl H, Ma X, Sedmak-Wells M, Fan IS. Collaborative enterprise system implementation. In: Sobolewski M, Cha J (eds) Concurrent engineering - The worldwide engineering grid. Tsinghua University Press, Beijing, 2004; 583-588.