

TOWARDS INDUSTRIAL SERVICE BUSINESS

Challenges in Designing ICT Support for the Networks of Companies

Sauli Hiippavuori, Markus Hänninen, Samuli Pekkola

Department of Computer Science and Information Systems, PO Box 35 (Agora), 40014 University of Jyväskylä, Finland

Kari Luostarinen

Metso Paper Inc, PO Box 587, 40101 Jyväskylä, Finland

Keywords: ICT development, systems integration, organization networks, industrial service business.

Abstract: Traditional manufacturing business is changing its shape to service industry. In addition to products, manufacturers are also providing specialized knowledge-based services. Although ICT is an enabler for such operations, its support for the activities of the networks of companies is still quite unknown. In these settings, ICT-related challenges are multifold. In this paper findings from a case study on constructing ICT support for industrial service business are presented. Technological challenges in designing and implementing systems to support daily business operations of industrial service business are listed.

1 INTRODUCTION

Currently industrial companies are moving towards service-oriented business operations. In other words, they are offering different kinds of support services to their customers. These include maintenance and repairing services, analysis of problems or potential problems, and fine-tuning and modifications for improved performance of the machine. To enable this, different kinds of ICT solutions; e.g. groupware and CSCW applications, knowledge management and expert systems, databases, and information hotels have already been developed (Biehl et al. 2004) and used e.g. in aircraft industry (Thompson 2004), shipping industry (Brook et al. 2003) and pharmaceutical industry (Rödter et al. 1998).

Biehl et al's (2004) stated that an infrastructure for remote connections exist and is ready to use. However, an efficient use and utilization of the technologies to support the operations of networked companies is far more complex (c.f. Heikkilä et al. 2005; Shaw et al. 2005). In other words, an infrastructure is just an enabler. The focus on technologies often ignores business strategy, organizational, user-related, and adaptation-related issues that have been identified relevant (e.g. Laudon and Laudon 2004; Vervest et al. 2005; Mumford 1983). As these

issues have their impact on the introduction, use, and acceptance of technologies they cannot be forgotten.

Although we study technologies, we dive into the complexity of industrial service business environments. We study a network of two companies with dissimilar objectives, cultures, working practices, histories etc. The companies have recognized a need for tighter cooperation so that they can survive in changing, global business environment. However, they do not know how it can be done in practice. Thus, in the paper, we try to identify a set of different technology-related issues (they turned out to be challenges) that need to be addressed by different parties – companies operating in the network, service providers and their customers, and the developers of ICT solutions –when developing industrial service business.

2 RESEARCH APPROACH

The case study is performed in a network of two organizations: service provider (a paper machine manufacturer) and their customer (a paper mill).

A paper mill is a complex construction where more than 10-meters-wide stream of paper runs through the machine as long as 160 meters at almost 2000 meters per minute. A paper mill (and a ma-

chine) is a set of interlinked machines using bearings, rods, connectors, pumps, gaskets, cylinders, drive belts, and numerous automation systems and computers to control, monitor, calibrate and adjust it. The machines, although they look the same, are unique. Depending on the paper grade, they are configured differently, use different kind of pulp, and have their own history of “updates”, i.e. newer computers or sensors. This complexity sets requirements for its operating staff – they have to handle a myriad of different systems and computers and be able to combine that information when fixing problems. However, currently economical situation is changing and such expertise is not afforded to keep in-house.

Paper machine manufacturers are also struggling with a changing business environment. New paper machines are not bought in masses but only small upgrades are invested. The paper machine manufacturers need new business opportunities, so they have started to offer services to paper mills. In this respect, there is a desperate need for industrial services both at the paper machine manufacturer and at the paper mill.

We have studied the difficulties in establishing industrial service business. We have worked with the companies for more than 2.5 years developing ICT solutions to support their floor level activities. The aim was to synchronize the workflows and support cooperation between groups of experts in two organizations. For this numerous interviews and workshops were organized to understand the problems and challenges of a new business model and their implications to ICT solutions.

3 NETWORKS AND SERVICES

The changes in the business concepts emphasize networking. In principle, the networks provide a knowledge base with greater number of people understanding and being able to work on complex and unique machines. The networks consist of specialists either from the same employers (internal networks) or from the service provider’s connections to other companies (external networks): subcontractors, suppliers, customers, even competitors. As there is very seldom just one supplier but many delivering different parts of the machine and of its automation and control systems, also the skills to offer services appropriately need to be obtained from several partners. Consequently they need to coordinate their activities carefully and implement them effectively as the timeframe for maintenance is limited to a bi-monthly halts of the machine.

The novelty of co-operation, different organizational cultures and lack of common practices creates several problems. In the interviews, both paper mill operators and service providers acknowledged that the opposing does not fully understand the service process, and that causes problems. Also, the lack of contextual information has turned out to be problematic.

4 ICT IN SERVICE BUSINESS

The companies have utilized dedicated solutions for some particular purposes. Data collection systems, monitoring and maintenance systems, diagnostic and process analysis tools, reporting systems, etc. are in use. These systems and the lifecycle of a paper mill (upgrades made on different parts of the paper machine) have led to a fragmented ICT infrastructure. Because of the number of parties involved in upgrades and operations, an architectural ICT design has not been done, as illustrated in Figure 1.

Different applications, devices and systems in use can be identified from Figure 1. For example, at the mill the data is collected through different sensors and meters in the automation systems. This data is utilized by operators and maintenance personnel in different applications (process analysis tools, configuring and data collection tools, databases containing process history). Yet there is no integration between them or between them and the business systems. It needs to be done *manually*. Although the need for the deeper integration has been identified, the lack of indication of explicit revenues and rigid work practices have restrained the integration attempts. Manufacturer’s experts share the same applications with the paper mill personnel.

ICT has consequently two functions; as an *enabler to create an infrastructure* for the network of organizations and for the remote services and *to support the service processes*. The infrastructure is needed both inside the organizations and between them, complicating its establishment. The execution of service processes and the delivery of the service products must be supported by ICT solutions and applications. This kind of combination of different functions enables industrial service business.

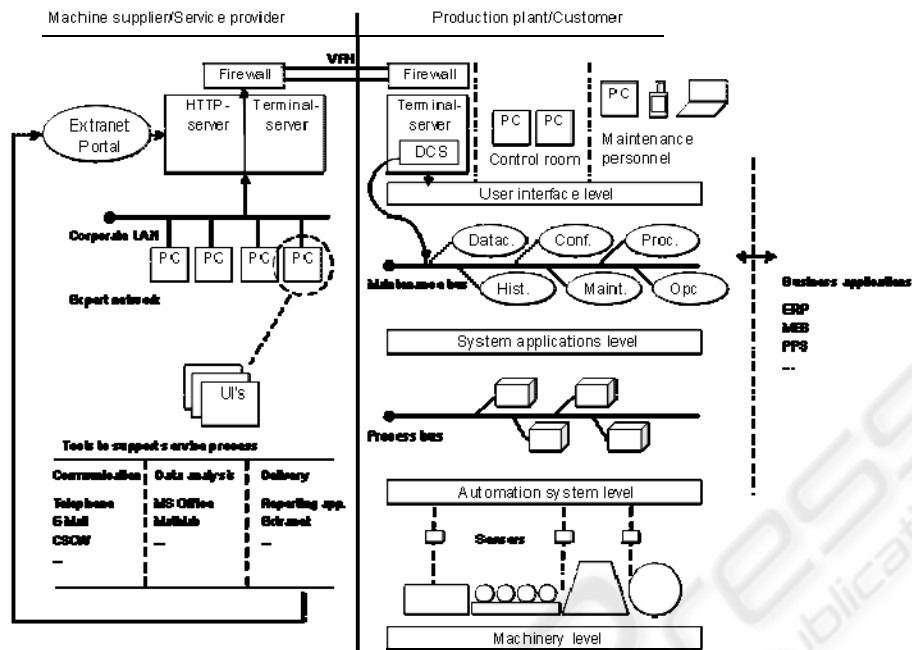


Figure 1: An example of information systems architecture in industrial services; manufacturer (left) and paper mill (right).

5 TECHNOLOGY-RELATED CHALLENGES

Biehl et al. (2004) argued that different kinds of ICT solutions have already been developed to support service business. However, these solutions do not support existing business and work processes at large as they are utilized in solving problems in specific areas of service business (c.f. Heikkilä et al. 2005; van Liere et al. 2004). The systems are lacking either the infrastructure or the process support being unable to provide high-quality services. This is a challenge when the size of the networks increases. In our case, a number of parties are offering their services for both the machine manufacturer and the paper mill *in cooperation*. To support this kind of joint business, a common gateway or interface through which the organizations could interact and share information becomes invaluable (Sihn 2003).

Deepened co-operation leads to increasingly shared business processes. Companies can no longer depend on their internal processes as more and more boundary-crossing transactions and business operations become common. This sets an obvious requirement also to an ICT infrastructure – how to support shared business processes and operations while simultaneously keeping intra-organizational issues safe. Yet that information, e.g. order volumes, might be essential for the service.

As the work environment is becoming increasingly distributed, the importance of ICT support increases. Solutions developed to support service processes satisfy only the primary needs of the specialists, but do not support them adequately. Integration on both system and user interface level, as well as in the adaptation of new systems, is a major challenge identified.

The value of the services is concretized once the data is analyzed, reformed, and delivered back to the customer in different forms (reports, proposals, etc.). The value the customer experiences is dependent on the outcome and the production process (c.f. Grönroos 2001). This stresses the importance of visibility and transparency of the service processes. In our case the customer gets only a 10-page-long report having no means for follow the analysis process. This could last several weeks or months, leading to the “simple” report. The lack of visibility reduces the perceived value of the service and may easily lead the proposed actions to be neglected.

All this sets requirements for the development of ICT infrastructure. Particularly the interoperability of the different systems and applications is emphasized. However, in our case the only point of integration between these systems is the user. Some development attempts have been initiated and some improvements have been made, but the breakthrough is still to come.

6 DISCUSSION

Technological solutions have been developed to overcome aforesaid challenges, but, as illustrated, so far the value of these solutions has been close to zero. They have been developed separately for small, specific needs, which have resulted fragmented application architecture that fails to support the work processes adequately. Also, because of the life-cycle of the paper machine, the systems at the paper mill are developed purely for their own needs. They are not even designed to have external connections and to support service business as information producer. Yet they are perceived as one by the service provider.

Integrating these solutions for a service-oriented application architecture has been a topic of discussion in the companies. Yet the task is highly complicated. A generic platform and loosely-tied integration of applications is needed, but it is not enough. As only a part of the information can be collected from the remote systems, its correct interpretation sets a need for contextual information. This, as turned out in our case, becomes challenging as appropriate experts are traveling between their own organization's sites or between them and customer site. The question is not only having access to data but also having access to experts.

Technological challenges for industrial service business can be summarized as follows:

- Systems are not developed in accordance to networked environment, and they are lacking a dynamic and loose coupled network.
- System architecture is fragmented consisting of separate solutions for specific purposes. Designing new system architecture is needed but may turn out to be impossible.
- Platform technology to enable service innovations, development and remote service application concepts does not exist.
- Lack of interoperability between applications and systems in the network causes that the integration between business applications and connections to external systems is difficult.
- Lack of technical interoperability between organizations does not support delivery and visibility of service products.
- Applications do not form a solid entity or support workflows.
- Operational interfaces do not support fluent cooperation or communication limiting interaction between service provider and customer.
- Knowledge created in the service process cannot be shared and utilized.

These are even more challenging when the transition from product-based industry to service-oriented business mode is considered; while we are still struggling with technological issues, that, by solving them, would enable industrial service business, we are also trying to change business environment and organizational practices. So, although all this needs to be done concurrently, we are still in a situation where the base, i.e. ICT infrastructure in its entirety, is not rigid and well established. Although Biehl et al. (2004) argued for the existence of the ICT infrastructure, our case argues against that. In fact, we have bits and pieces of the infrastructure, but it is not complete or coherent. There are still several issues that need to be considered before the organizations can operate in a service-oriented business mode either as service producers or service consumers.

REFERENCES

- Biehl, M., E. Prater, J.R. McIntyre (2004). Remote repair, diagnostics, and maintenance. *CACM* 47(11), 100-106.
- Brooks T., Chen S., Lee K. (2003). IEEE 1451 smart wireless machinery monitoring and control for naval vessels. *13th International Ship Control Systems Symposium*, April 7-9, Orlando, FL, USA.
- Grönroos, C. (2001). *Palveluiden johtaminen ja markkinointi* [Service management and marketing: in Finnish]. Helsinki, WSOY
- Heikkilä, J., M. Heikkilä, J. Lehmonen, & S. Pekkola (2005) Smart ICT support for business networks. In: Vervest et al. (2005) pp. 389-403
- Laudon, K. & Laudon, J. (2004) *Management Information Systems: Managing the digital firm*. Prentice Hall.
- Mumford, E. (1993) *Designing Human Systems: For New Technology*. Manchester Business School.
- Rödder, H., Kieckhöfel, O. & Manzke, S. (1998). Internet-based maintenance support for customers and manufacturers. *Industrial Electronics Society. IECON '98*. pp. 2084 – 2088.
- Shaw, D., R. Snowdon, C. Holland, P. Kawalek, B. Warboys, (2005)., The Viable Systems Model Applied To A Smart Network: The Case Of The UK Electricity Market, In: Vervest et al. (2005). pp. 289-305.
- Sihn, W. & Graupner, T.-D. (2003). e-Industrial services for manufacturing systems: differentiation through internet services. *The 36th CIRP-International Seminar on Manufacturing Systems*, 3.-5. June 2003, Saarbruecken, Germany.
- Thompson A. (2004). Wireless and Internet communications technologies for monitoring and control. *Control Engineering Practice*. 12(June). 781-791.
- Van Liere, D. W., L. Hagdorn, M.R. Hoogeweegen, P.H.M. Vervest (2004) Embedded coordination in a business network. *J. IT* 19(4) 261-269.
- Vervest, P., E. van Heck, K. Preiss, and L.-F. Pau (eds). (2005). *Smart business networks*. Springer.