IT tools for communication in multi-site manufacturing firms

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Abstract

For manufacturing firms competing and operating globally, the information system is of decisive importance for communication between the different actors within the manufacturing enterprise. It should be as easy to communicate with the colleague working next door as with the colleague working in another country. This paper deals with information and communication technologies and how multi-site-manufacturing firms adopt these. A framework incorporating time and place perspectives is used to categorise different information technology (IT) tools for coordination, cooperation and communication. We have interviewed managers in three firms with multi-site environments; both IT managers at central headquarters and production managers at geographically dispersed manufacturing plants, to provide a wider perspective on the implementation and use of IT tools.

Keywords

Multi-site manufacturing, Information technology (IT) , Communication, Computer-supported cooperative works (CSCW) , Groupware.

1 INTRODUCTION

As a response to increasing global competition, some manufacturing firms globalise their manufacturing operations in order to achieve the best network of manufacturing and supply facilities relative the marketplace, see e.g. Boone et al (1996). Some operate in supply chains, supply networks or extended enterprises incorporating different firms working together. Others try to accomplish manufacturing excellence on their own, creating internal manufacturing networks consisting of business units of facilities within a single firm. In either case, information sharing and communication among facilities are fundamental to maintain competitive advantages, see e.g. Ghoshal et al (1994). The information technology (IT) tools that can be used for communication, coordination and cooperation between different actors in a manufacturing enterprise are steadily maturing and new tools are emerging. It is becoming as easy to communicate with the colleague working next door as with the colleague working in another country.

This paper deals with the implementation and use of information and communication technologies in multi-site manufacturing environments, extending the work in Jessen (1996). We focus on internal networks, i.e. concerned with different facilities within a single enterprise. In order to capture the level of application we have interviewed managers in three firms with multi-site manufacturing. These firms are all considered high performers in terms of manufacturing efficiency as well as early adopters of new technologies. IT managers at the central headquarters as well as production managers at manufacturing plants located elsewhere were interviewed, focussing on how these firms implement and use different IT tools and the impact of these technologies on their way of working. Of special interest is to investigate the similarities and dissimilarities of the perceptions of various IT tools for communication between, on the one hand, the headquarters, represented by the central IT manager, and on the other hand, geographically dispersed manufacturing plants, represented by production managers.

First, we will present a framework for the categorisation of IT tools for communication, coordination and cooperation. This framework is two-dimensional in time and place. We then briefly describe the manufacturing environments for the three companies. The results of the study in terms of implementation and use of IT tools in the three companies are then presented. Finally, some concluding remarks are provided.

2 IT TOOLS FOR COMMUNICATION, COORDINATION AND COOPERATION

There are a number of concepts available describing various perspectives on IT tools for communication. Among the most commonly used are computer-supported cooperative works (CSCW), groupware, group support systems (GSS), and computer-mediated communication systems (CMCS). These are often described as being quite similar; the possible difference being that groupware tends to be judged as more technology-oriented, whereas the others are more conceptual.

In this section, we provide an overview of IT tools for computer-supported cooperative works, sometimes referred to as groupware. The framework for categorising application tools contains two basic dimensions: time and place. There are four fundamentally different time and place interactions possible, see e.g. Gillenwater et al (1995), Gray and Igarria (1996), Grudin (1994), and Khoshafian and Buckiewicz (1995). It is fundamentally easy for a user to grasp the nature of interaction among the communicating participants for the combinations that comprise the framework; same or different time versus same or different place. In Table 1, some IT tools are categorised accordingly.

Detailed descriptions of most of these tools are found in Jessen (1996) and Davis and O'Sullivan (1998). Table 1 illustrates the fact that there exist numerous tools for all time and place perspectives. The research question of this paper concerns the extent of the actual implementation and use of these tools in multi-site manufacturing firms; a type of manufacturing environment that is likely to benefit from technologies that facilitate information sharing and communication.

Table 1 Categorisation of IT tools for communication, coordination and cooperation, with respect to different time and place interactions

	<i>Same time (synchronous)</i>	<i>Different time (asynchronous)</i>
<i>Same place</i>	Electronic meetings Electronic whiteboards Team rooms Group decision support systems	Document management systems Electronic bulletin boards Mailboxes
<i>Different place (distributed)</i>	Desktop videoconferencing Document conferencing Screen-sharing Teleconferencing Videoconferencing Web-based "chat rooms"	Advanced messaging, e.g. voice-mail Electronic data interchange (EDI) Electronic mail (e-mail) Internet Workflow

3 MULTI-SITE MANUFACTURING ENVIRONMENT

We will use a few models that have emerged from the global manufacturing area to describe the environment of the three multi-site-manufacturing firms. The first model stems from Porter (1986). Shi and Gregory (1998) present a similar model, using the same set of dimensions that are fundamental to the design of a (global) manufacturing network, namely configuration, meaning the geographical dispersion of manufacturing activities (dispersed or concentrated), and coordination of these activities (from low to high). Companies A and C are geographically dispersed (high foreign investments) with high coordination of activities. Company B is geographically concentrated with low coordination, employing an export-based strategy with decentralised marketing.

The focus of the manufacturing network can be drawn from either the product or process. A product focus at the enterprise level means that facilities are equipped to manufacture complete products and can serve a regional market, whereas a process focus means that the average product is processed through a sequence of production stages at different facilities. In the latter case, the need for communication, coordination and cooperation between facilities is greater. Companies A and B were in the process of converting from a process focus towards a product focus during the study, whereas Company C has maintained a process focus with specialised plants.

The third model by Ferdows (1997) deals with the strategic roles of foreign factories in an international manufacturing network. Again, two dimensions are used. The first is concerned with the strategic reason for the site location, i.e. access to low-cost production; access to skills and knowledge; or proximity to market. The second is related to the scope of site competence – high or low. The Company A plant is a ‘lead’ factory with the ability and knowledge to innovate and create new processes, products, and technologies for the entire company. The plants at Companies B and C are ‘source’ factories, which are considered to be established to provide low-cost production, but have enough resources and the expertise to produce parts, or a complete product, for the company’s different markets.

4 RESULTS OF THE STUDY

The three companies have similar network structures. Internal communication takes place over local area networks and Intranets. Each of the companies has access to a wide area network (WAN) that connects the globally distributed sites. The WANs are equipped with decryption and encryption facilities to enable safe transmission of sensitive data. The connections to the Internet are limited and controlled by a gateway. A ‘firewall’ protects against intruders from outside the enterprise. In the following sections, we will present how different IT tools are used at these companies.

4.1 Same time and same place

The computer support at company A is very limited. Meeting rooms are equipped with a connection to the company's network. Computers are only used for demonstration purposes concerning new computer systems or capabilities on the network. A set of several networked desktop computers is not judged as being necessary since the main goal of a meeting is to talk to and see each other.

Company B has a camera-whiteboard in addition to the meeting room equipment of company A. Copies can be printed out and handed to the participants, who can concentrate on the discussion and do not have to take notes simultaneously.

The meeting rooms at company C are set up in a similar way as company B. There are current efforts to create a data warehouse, where all information about the corporation can be provided from one place. However, this is still far from being a reality.

4.2 Same time and different place

At company A, videoconferencing is considered a mature technology that can reduce the amount of time people spend on travels. Upper management frequently uses these tools. Videoconferencing is extremely useful for very short meetings with few urgent matters, since it would be difficult to justify long distance travels for such meetings. Documents are exchanged by fax or e-mail, since the time delay is acceptable.

Videoconferencing is a major tool to improve distributed communication at company B. The equipment is not reserved for upper management. There is high demand for quick coordinating meetings also for tactical and operational decision-making. A major obstacle is low accessibility, since even for biparty videoconferencing the appropriate room must be free at both ends. Thus, there have to be advance preparations.

At company C, videoconferences are mostly used by upper management. Starting in the middle of the 1980's the use has increased dramatically the last 2-3 years. Accessibility is a major problem, since there is no central booking schedule on the corporate network. Also, communication over different time zones is not straightforward, since one party has to agree on a night meeting. Company C uses screen-sharing facilities, even at the plant level. A few success stories have been reported, e.g. when solving a severe computer problem at a remote plant using synchronous interaction. Explanations and comments were made over the telephone network. Also, the CAD system provides screen-sharing facilities as well but data can only be entered at one end. This facility is not often used since designers tend to prefer to meet and talk about drawing at one table.

4.3 Same place and different time

An E-mail system as well as a voicemail facility is provided at company A. There is a spreadsheet placed on a common area on the network that works like a bulletin

board. Everyone has access to this board, displaying e.g. factory plans and performance. It contains several graphs with explanations such that even those not familiar with manufacturing or business can understand them. The same information is also available at physical bulletin boards at several locations within a plant. The central IT department estimates that there are several hundred such bulletin boards or homepages on the company Intranet.

At company B, the Intranet is seen as a major provider of information. It is considered a pull type system in that the information that is needed is search for and retrieved. Reports are left on the Intranet on a topic specific homepage and the persons who are normally provided with a copy of the report are referred to the Intranet.

The Intranet is considered to be a major communications tool at company C. At the manufacturing plant, many applications and homepages have been built as information warehouses for anyone searching for a specific topic. The implementation of quality assurance manuals and PC-on-line-help for PC installations is quite extensive.

4.4 Different time and different place

The high amount of daily incoming e-mail messages is becoming an extreme burden for the managers at company A. It is even getting worse at higher levels in the organisation. The company is therefore looking for reliable filters. The use of voicemail is highly variable; some use it as an advanced answering machine, whereas others do not use it at all. Generally stated it is not used to its full extent. EDI is used for facilitating trade. A considerable amount of paper is reduced.

The issues regarding e-mail and voicemail at company B is quite similar to company A. EDI is used to link suppliers to the production area. The use of EDI is expected to lose in importance in the long run, since a move towards Internet contacts is already emerging. The contacts with customers need negotiation flexibility wherefore EDI is not used.

Company C has no problems with "junk mail". The personnel are disciplined. Simple reports that say that an order has been executed or if no activity is required on behalf of the recipient are not mailed. EDI is used with some 500 suppliers and is judged a major tool for coordinating and improving the supply chain. A workflow system shows the production flow through the entire manufacturing plant. Every product can be tracked according to its product structure. Every department at the plant can access the workflow system and check the production status for any specific product. The system is a client/server system based on a Windows NT environment.

5 CONCLUDING REMARKS

Upton and McAfee (1996) outline three important factors that determine the ease of information sharing for real virtual factories. These are the stage of relationship

between any two companies (married, engaged or dating), the lowest common denominator of IT sophistication among partners (from experienced to naive), and the level of functionality (simple data transmission, data access, and telepresence/access to applications). The companies in this study are 'married', have relatively high levels of IT sophistication, and has the highest level of functionality through WANs. Still, when comparing the implementation of IT tools for CSCW in these three companies with the possibilities offered by research and software products, it can be concluded that practical implementation is still cautious in some fields. The uses of some tools such as e-mail, videoconferencing and electronic bulletin boards are wide and sophisticated, whereas other tools are not applied at all, e.g. group decision support systems, desktop videoconferencing, and document management systems. Thus, there still seems to be a gap between the requirements from an application point of view and the theoretical capabilities of the CSCW tools. The main reason for not implementing some tools is the lack of software maturity, e.g. for large applications with several thousand users. This study also supports the results in Warkentin et al (1997), in that the personal meetings between colleagues and partners at geographically dispersed manufacturing sites are still very important. Typically, the central IT managers have a wider, more strategic perception on the use of new technologies, whereas the local production managers are more interested in the tools that can be made useful today in aiding the decision-making process.

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8 BIOGRAPHY

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