Emerging E-Communication Technologies and Their Usage in Project-Based Organizations

MATS ENGSBO AND MAQSOOD SANDHU
Swedish School of Economics and Business Administration, Finland

This article examines how the introduction of electronic communication in the Architectural-Engineering-Construction industry is impacting on two domains of management, namely production management and project management. In the study, traditional organizations are associated with production management, and project-based organizations are associated with project management. By looking at the usage, we want to pin down which e-communication tools are more tightly coupled to the form of management. The data for the study were collected through two surveys, one total population survey in the Finnish and Swedish house building industries as representatives of traditional organizations, and a focused survey in the project-based industries. Our results showed that electronic document management and scheduling were more prominent among project-based organizations, as these firms exhibit more inter-organizational communication.

Key words: e-communication, project management, production management

Introduction

Electronic communication is a system used as means of sending or retrieving messages through computer or Internet connections. Today this includes a multitude of communication tools, ranging from simple forms such as e-mails to more complex forms, e. g. electronic document management (EDM) systems, enterprise resource planning (ERP) systems and project planning systems. The introduction of different e-communication tools may alter the firm operations, providing firms with innovate venues for impacting their management processes.

Davies and Hobday (2005) use the term 'project business' to refer to 'organizations – which may be entire firms or units within firms – that deploy projects to achieve major business objectives, including all firms which design and produce complex products and systems (CoPS)'. For the purpose of this study, project business is defined broadly to encompass all business functions in which many stakeholders are involved in the process.

Past research on improving communication has mainly focused on internal organizational communication, and most of this attention has been on the availability of communication for intra-organizational communication of traditional business organizations (Amaratunga, Sarshar and Baldry 2002; Greasley 2003). However, the distinctive characteristics (uniqueness, uncertainty and complexity) of project business with its distinctive communication needs, mean that any attempt to improve communication on the basis of traditional organizations is unlikely to fulfil the special requirements of project business. In particular, a focus on the company's internal communication fails to recognize the importance of communication with external networks, partners, and other stakeholders, in the conduct of project business. Indeed, researchers in the area of project management have largely neglected such inter-organizational communication that can be supported by adoption of available technologies or developing new technologies.

Very little attention has been paid to the integration of inter-organizational and intra-organizational perspectives of electronic communication in project-based organizations, especially in the context of e-communication availability and its actual usages in engineering, procurement, and construction (EPC) projects. This represents a significant gap in the literature: project-based organizations (PBOS) must be able to conduct efficient business operations by utilizing new technology.

Therefore, the driving force for this study is to reveal the gap in research on firms engaged in e-communication covering project-based organization, and to show how traditional organization e-communication differs from these organizations. The effort is to elaborate some thoughts and views on e-communication which interrelate the firms' inter- and intra-organizational communication usage. In line with the integrated communication and available technologies, we discuss its usages in PBO. Therefore our main research question is: 'How are project-based organizations using e-communication in the form of available technologies, and how does this differ from traditional organizations?'

Our research objective is presented in figure 1. The first step in addressing the above research question is to establish the difference between PBOS and 'traditional' businesses organizations (TOS). The organizations that are involved in project business are always formed around the tasks involved with its stakeholders. Therefore, it is appropriate to establish a framework for the intra- and inter-communication applying the emerging technologies. Establishing

Traditional organizations   *Project-based Organizations*

Characteristics $_{TO}$ Characteristics $_{PBO}$

Inter-organizational
and intra-organizational
communication

Communication
needs $_{TO}$ Communication
needs $_{PBO}$

Available
communication
technologies

Adoption of ICT $_{TO}$ Adoption of ICT $_{PBO}$

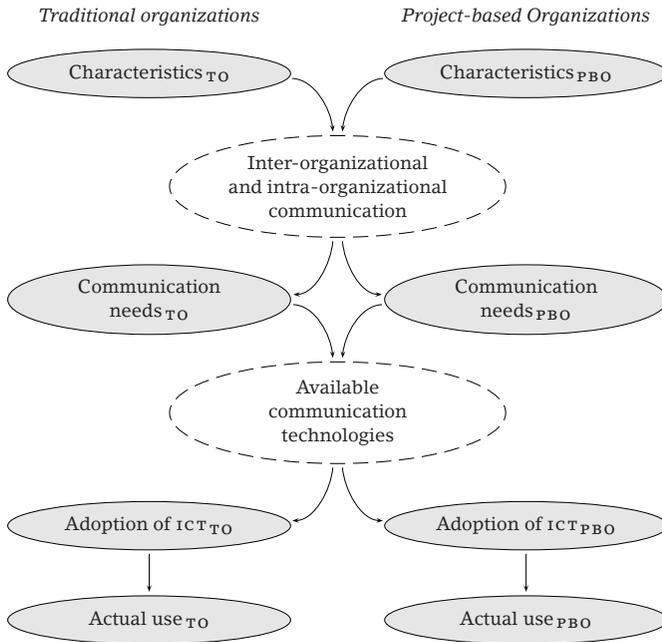Actual use $_{TO}$ Actual use $_{PBO}$

FIGURE 1   Overview of the research objective

such a framework will allow us to gain better understanding of how firms communicate with their internal and external partners. The communication needs specify what sets of available technologies can be implemented by the firms, thus leading to the actual usage among the two groups of organizations. In this we will locate whether there are any differences in the actual usage of e-communication between the two different forms of organizations.

The rest of this paper is arranged as follows. The next section reviews the literature and pins down the differences between traditional and project-based organizations. The third section describes communication needs of project-based organizations. It also elucidates communication styles between such organizations with inter- and intra-organizational perspectives. The fourth discusses the emerging technologies and how these are adopted. In the fifth we present the methodology and data, along with analysis of the data. Finally, the conclusions and suggestions for future work are offered.

Project-Based And Traditional Organizations

The major characteristics of project business are: (i) uniqueness; (ii) complexity; and (iii) discontinuity. A project is unique in the sense

TABLE 1 Characteristics of project-based organizations and traditional business organizations

Project-based organizations	Traditional business organizations
• Temporary arrangement	• Continuous operations
• Emphasis on goals	• Emphasis on working processes
• Dynamic	• Stable
• Flexible	• Inflexible
• Non-hierarchic organization	• Hierarchic organization
• Decentralized decision making	• Centralized decision making
• Adhocratic	• Bureaucratic

that every project differs from another in size, type, customers, suppliers, volume, price, and so on. It is complex in terms of the technical, financial, political, and social factors involved. Finally, it is discontinuous in terms of the high degree of discontinuity in economic relations between suppliers and the customers.

The nature of project business means that organizations involved in project management must be specialized in communication if they are to offer a full range of services to their customers, cope with demand fluctuations, and shorten response times. Past research (Sandhu 2005) has placed emphasis on the importance of communication and improving communication processes focusing on internal organizational capabilities, and most of this attention has been focused on the communication and process development. Most recent contributions on project approach point out that project approach is becoming more popular day-by-day in the modern economy. It has emerged as a specialized area of management to meet the needs of organization in order to accomplish specific objectives and goals. Today project management approach is characterized by newly developed methods and techniques that are continually advancing and evolving as a result of ongoing research and practice.

In spite of the increasing practice of project approach, the project managers are still perplexed because of two reasons. First of all, the goals of the project are likely to change and become more demanding under the changing external circumstances which are beyond company control. Secondly, the traditional techniques of handling the project are not always a proper fit in more recent times. The reason for this lies in the fact that the organizations are also growing along with the external environment. It is clear that project management will be of critical importance in future because of dynamic external conditions.

Project organizations and the established methods and tools of project management require further investigation. Inside the rou-

tine organization, there are constant and well known institutions like functional groups, departments, plants and branches where knowledge and experiences are acquired, stored, and dispersed. Hence, these institutions can be asked and their knowledge and experiences can be retrieved, despite the specific appearance of the collections, e. g. in documentation, records, competent employees, or hidden within the working process.

Projects are distinct as temporary organizations with particular objectives, detailed tasks, and restricted time and budget. When a project is finished, normally there is no institution or body left where existing knowledge can be accessed. Meeting spots, like groups, departments, plants, branches in the regular organizations, no longer exist after the ending of a project.

After the ending, the organization of the project is broken up and no longer exists. In addition it will be hard to discover which employees worked on a recently finished project, who were accountable for specific tasks, and where these employees are working now within the company. These types of troubles will increase with the number of projects running in parallel, organized securing of knowledge and experiences is even more important in multi-project management. Companies that are not systematically securing knowledge gained in projects for later usage run the risk that knowledge and useful experiences may vanish with the end of a project. The majority of companies are investing in innovative project work but investing nothing in evaluating and learning from it. Within project management, efficiency and effectiveness of the work of the project's team members is significant. Companies learn the largest part within projects, but cannot communicate their experiences. At best, project team members keep the knowledge and experiences as individual knowledge, which they may use in the future.

Therefore, this study presents a framework that is elaborated on the basis of the reciprocal interactions of activities within and outside the organization–thus providing a coherent basis for continuous business-process improvement. Therefore, the differences in characteristics and communication needs are great but still the similarities are even bigger, implying that technologies for supporting PBO and TBO are able to be cross-productive.

Intra- and Inter-Organizational Communication

Adriaanse and Voordijk (2005) state that the contract, the frames of reference of the parties involved and the interests of the parties involved (together with a lack of trust) are three major factors influ-

encing inter-organizational communication (i. e., communication between client and contractor) in the construction phase of construction projects. Here we argue that in projects the initial phases are extremely important, as the need for pre-contractual communication is crucial as well as the need for early risk analysis, implying that much communication takes place before an actual contract is drawn up. In the early phase of the project, the communication could take many forms, communication can be verbal, written (e. g. textual, drawings) or non-verbal (e. g. gestures).

The project-management literature has focused mainly on intra-organizational communication aspects (Almeida, Song and Grant 2002; Tsai 2001) – how a project is planned, controlled, and delivered. But, communicating in a project is conceptually different from the traditional stable manufacturing organizations. Management of a project involves management of that project's uniqueness, complexities, and uncertainties, and this requires both an intra-organizational perspective and an inter-organizational perspective. The uniqueness, complexities, and uncertainties should be managed simultaneously. If the focus is on the communication in networks, rather than in the single firm, issues that arise both inside and outside organizations demand the availability of appropriate communications tools. In accordance with this view, the study focuses on availability of tools for communication and their actual use in project-based organizations.

A project business involves intra-organizational and inter-organizational networks that require different types of knowledge and communication. A framework that combines intra-organizational networks with inter-organizational networks is required to communicate efficiently and effectively throughout the business operations. This will allow the project manager to focus on how to communicate in various situations in order to manage the project-based organizations.

Within project management literature Thompson and Richardson (1996) have argued that organizational systems have become more open, complex, and political. This creates a greater level of uncertainty for the organizations and contributes to an unstable and changing project environment. Artto and Wickström (2005) say that the project business must be managed by external factors such as characteristics of the product and the competitive environment. This high level of uncertainty challenges traditional approaches to process formulation and communication. Thus, the way of communication will have an impact on these kinds of failures, as understanding

how to remedy them would point to new applications of the communication technologies.

Earlier research on intra-organizations has focused mainly on environments that could impede the development of corporations, rather than those from which benefits are derived (Brady and Davies 2004; Collyer 2000). However, most organizations are in an 'intermediate context', whereby processes can be developed and benefits can be mutually derived. The important organizational characteristics for successful project development include openness in communication, adequate environmental scanning, management support, and established organizational values. In addition, intra-organizational business processes have an important complementary function (along with inter-organizational processes) in fostering the planning and execution of a project.

Electronic Communication Technologies and Their Adoption

Traditional forms of communication in organizations are carried out through face-to-face interaction; paper-based drawings, letters and graphics; through telephone calls. E-communication is doing the same thing, but electronically. Our definition of electronic communication (e-communication) is a system used as a means of sending or retrieving messages through computers or Internet connections. E-communication can take many forms, whether it is synchronous (real-time) or asynchronous; textual/verbal only or multimedia.

The cost of communication has decreased compared to traditional means (e.g. distribution of paper copies vs. attaching a file to an e-mail), the speed of communication has increased rapidly (e.g. time for an electronic message to arrive compared to a snail mail delivery), and the technologies involved in bringing e-communications are becoming ever more versatile (e.g. both video-conferencing and textual communication simultaneously). There are still some disadvantages with e-communication, e.g. lacking interpersonal exchange and legal implications (e.g. validity of a signed paper compared to one sent by e-mail).

During use, there is often some form of adaptation of the technology as the firm or individual learns more about the technology. Often a technology is implemented and tested in a simpler mode or not fully. Further, it implementation barriers exist and can be identified and handled from different perspectives, e.g. the top-down effects on multi-level it implementation barriers with links to implementation coping strategies (Stewart, Mohamed and Marosszeky 2004).

At the industry level – industry nature in the form of competitiveness, cost sensitivity, resource limitations and fragmentation – there may be barriers that inhibit it implementation. At the organizational level, the lack of it investment justifications and available resources may inhibit implementation, as well as problems with strategic foresight. At the project level, the nature of the projects themselves (uniqueness, complexity, and discontinuity) provides barriers for it implementation. In a study of the Australian construction industry (Stewart, Mohamed and Marosszeky 2004), the most significant barriers at the project-level were tight project time-frames that inhibit training and experimenting with it, followed by limitations in it expenditures, lack of it leadership and low levels of technological literacy.

The issue of evaluating it costs when developing an it infrastructure that can be economically justified are also a venue that needs more focus and development, especially regarding indirect human costs (e.g. management time on planning and integrating a new system, internal system support) and indirect organizational costs (e.g. productivity losses, resistance to change) (Love and Irani 2001). The concept of the it lifecycle is providing firms with further complexity in the investment situation but also a more realistic picture of what can be expected from the it investment.

Communication processes (i.e. exchange of information) can occur either internally or externally to the firm. Intra-organizational e-communication is in its simplest mode mere electronic mails (or fax), while more enhanced e-communications over Intranet or local networks can be streamed either in different forms: text, audio and/or visual. The interface with external parties provides support for order-taking, procurement, collaboration or other processes. Applications exist for constructing and managing relationships these relations, in the forms of Extranets, edi, e-commerce, electronic document systems (edm) and so on.

The adoption decisions may also be based on the dimensions of adoption initiative and innovation stimulus, making the adoption decision pro-active, reactive, forced or even arbitrary. Further, the choice of electronic business solutions is as well dependent on criteria like relative network power, integration level of solutions, product characteristics and supply chain relationships (Ratnasingam 2000). The spread of e-communication varies across industries, networks and even organizations. The rate, extent and frequency of adoption of e-communication all quantify technology adoption according to the economic-rationalistic approach (Fichman 2004). The critique

against the so-called dominant paradigm of ICT innovation coupled with economic and rationalistic behaviour is that the focus on quantity of adoption and the inherent beneficial perceptions of innovation may not paint a totally realistic picture. Adoption of transient technologies, prior adopters' affluence adoption and 'more is not always better' are factors that contradict the quantity approach for IT adoption.

When the firm decides whether to adopt e-communication or not, the complexity in the decision should be apparent. The decision is based not only on internal perceptions but also on the business milieu that the firms reside in. The determinants of e-communication adoption can be divided in to several different typologies: incremental vs. revolutionary, internal vs. external stimuli, key drivers (technological, economic, social, organizational drivers and barriers).

In communicating on a project, the mode and tool for communication may be set from the onset. For instances, in big construction projects, the use or non-use of electronic document management systems can be afflicted by the head contractor, and if used the systems may vary according to what collaborators the organizations communicate with.

Methodology

BACKGROUND

The objective of the present study was to describe the electronic communication in the Architectural-Engineering-Construction (AEC) industry and to compare PBOS with TOS regarding their use of key IT tools in communication.

The data for the study were collected through two surveys, one a total population survey in the Finnish and Swedish small house building industries as representatives of traditional organizations (TOS), and the other a focused survey in the project-based industries. In the second survey on PBOS no house building companies were involved. The respondents were project-management personnel at both the strategic level and the operational level. Both the surveys with similar questions are combined to investigate the plausibility of our assumptions. In total, 114 questionnaires were sent out and 46 answers to our surveys were received.

The data we are using is a subset of questions from two surveys conducted in a TO and a PBO environment, respectively. In this study we compare the answers from ten questions specifically focussed on e-communication from both surveys. The questions asked

were regarding e-communication tools that can be found in the organizations. These tools were design and planning with 3d modelling, internal communication networks in the form of Intranets and scheduling software, electronic document management, electronic procurement and communication platforms.

DATA COLLECTION

The TO survey was conducted among house building companies as a total population survey for Finland (conducted October-November, 2006) and Sweden (conducted March–April, 2007), where the firms were selected according to the following criteria: the firms belong to the SNI-classification 20301 that denotes producers of prefabricated wooden houses, and from these are selected the firms having more than nine employees. In the study, micro firms with less than ten employees were excluded. We exclude this category of firms in our study due to the size, as this puts restrictions on the firms' capability in the field of information technology investment. These restrictions are due to scarceness of financial and technical resources, and also because internal communication technologies are less necessary as the likeliness of face-to-face communication accentuates.

The firms in the study were mainly SMES. According to the Commission Recommendation 2003/361/EC on small- and medium-sized enterprises (SMES), small firms have between ten and 49 employees, while medium-sized firms are larger but have a maximum of 249 employees. There is also a condition about the turnover and balance sheet in accordance with each category. We sent the survey to 55 house building companies in Finland and 41 companies in Sweden. Response rate from Finland was 38% (21 answers) and 39% (16 answers) from Sweden in total 37 responses.

The second survey, the PBO survey, was conducted in September–October 2006, among SMES as well as multi-national companies (MNCS) that are located in Finland. The operations of the SMES were mostly local, while the MNCS have their offices around the world. The respondents represented companies involved in projects in the construction industry (excluding house building companies), electronics industry, and power-plant industry. The selection criterion for the PBO study was PBOS that belong to a project management club due to the fact that these companies allowed the researchers better access to the required information. We distributed the questionnaire survey to 18 CEOS, Directors and General Managers of PBOS.

We received nine replies, and one returned the questionnaire saying that he had retired from the project-based organization. Three

TABLE 2   Responses from the house building and project-based study

Size of firm	TO study Finland	TO study Sweden	PBO study Finland/MNC	Total
Small, 10–49	9	9	0	18
Medium, 50–249	10	6	5	21
Large, >250/MNC	2	1	4	7
Total	21	16	9	46

out of nine responding PBOS were MNCS having employees between 750 and 14,000 in some eighty countries, including Finland and Sweden. From one of the MNCS we received two responses from its two different divisions, thus making the number of responses from MNCS amounting to four. The remaining five companies were SMES, being largely operational in Finland and having some links with MNCS as a supplier.

The basis for judging the size of the respondents was according to the size of the project group. As a firm can be involved in several projects simultaneously, we asked questions about specific projects. Most project teams consisted of fewer than 20 personnel, although one manager stated that his team has 21–50 persons. Each respondent has been a manager over at least 20 projects to the value of 10 million to 300 millions EURO. The technical and engineering functions of the projects involved process systems, civil and structural work, mechanical engineering, electrical engineering, chemical engineering, technical instrumentation, and software engineering. The response rate to the questionnaire from these respondents was 50%. A reminder was sent to those who had not replied. Details of the respondents from each category are listed in table 2.

In the PBO survey, the respondents were general managers of projects and project managers. In the TO survey the respondents were either the CEO of the organization or the IT manager. The difference between the groups of respondents is due to the focus on projects in the first group and the fact that the 'traditional' organizations do not hold project managers. The customer focus between the two survey groups differs, as the customers of the TO are mostly private persons building a small house or a developer producing row houses. The customer group of the PBOS are mostly large organizations with high value of the projects.

ANALYSIS AND FINDINGS

The TO study provided some interesting details. In their communication to the customers, the house building firms all had homepages,

35% of the firms used 3D visualization and nine firms (24%) were in the process of implementing this kind of technology. It was more common amongst the Finnish firms than the Swedish to have 3D visualization for their customers. 3D visualization is used to display a model of how the finished product will look and as a basis for planning or selecting different options, such as colours, porches etcetera. Further, 37% of the firms used some form of customer relationship management (CRM) software or databases to keep track of customers during the process of delivering the finished house to the customer; 16% of the firms recognized a need for this kind of software, while 26% were in the process of implementing such software in their business processes. This was also relevant to the size of the firm, the bigger the firm, the more likely the firm is to have implemented 3D visualization and CRM systems.

Regarding internal communication, the use of Intranets was prevalent. Almost 60% of the firms had implemented Intranet solutions, but – interestingly – four Swedish firms had opted for not adopting Intranets at all. These firms were, furthermore, not the smallest of the bunch, but three out of the four firms were less than average among the respondents. The extension of Intranet with partner access into what can be labelled as Extranets was much less commonly used, only 24% allowed partners access through Extranets. This may be a quite obvious observation, but in order to allow partners access through an Extranet, there should be an Intranet implemented as a prerequisite for extranet communication.

Electronic document management (EDM) systems or project banks were used by 19% of the firms, which was unexpectedly high. Then again, this might point to what the respondent considers to be an EDM system or a project bank. A third of the respondents did not know what this term is. Once again, size mattered as six of those seven firms that had implemented EDM were larger than the average firm when considering turnover. Time-scheduling systems were used by close to 40% of the firms; once again there was a close correlation between firms which have implemented EDM systems and time-scheduling software.

On the procurement side, half of the firms admitted to using electronic procurement and of these 60% had integrated their procurement to some extent with their suppliers. When asking a direct question regarding the connection method for procurement, the use of traditional fax or telephone still constituted on average 48% of the connection method to the suppliers, while e-mail made up 38% on average. Proprietary systems were used by eleven firms in their pro-

curement process but only made up about 3% on average. EDI communication was used by only three firms, but had high percentages for two of these three firms: 30% and 20% of total procurements conducted on EDI systems. This is a typical trend, as once a firm chooses this method, it will use it as extensively as possible.

The PBO questionnaire survey consisted of PBOS using ICT-tools and their communication to customers and sub-suppliers including other stakeholders. The PBO questionnaire was divided into three parts A, B, and C, in addition to background information on the survey participant. Part A gathered information about project-based organization, which types of project, the sizes of the project team and the technical engineering function involved. The second part B was focussing on other issues which are not part of this study. Part C is the focus of this study, where we asked questions regarding e-communication technology and ICT tools. This part consists of similar questions as for the 10 main questions of the TO survey, so this part is where we make comparisons and draw conclusions for our study.

All the firms in the study had homepages, and MNCS used very high levels of e-communications in inter-organizational and intra-organizational contexts. For example, to integrate and coordinate resources across projects they have been using project management tools like time-planning, cost-planning and control, quality management, risk management, deviation management systems, system designs, and customer relationships management (CRM). As 3D is considered important to design in the projects, almost every organization was using 2D and 3D and some platform to communicate with their customers. Two out of the nine responding firms did not use 3D, and both were among the smallest of the SMES responding. About 90% of PBO used CRM, as their customers requested to register complaints etcetera about the products. Customers also keep such databases to analyse the performance of their suppliers. The use of intranets was common; almost all MNCS and SMES were using intranet solutions. All MNCS and SMES used electronic procurements and had integrated their system with their suppliers.

The main findings from the questionnaire survey are summarized in table 3. An important finding from the survey was the difference in attitude among employees of TOS and PBOS. According to the respondents from TOS their employees were more committed to the company strategy than to projects, whereas the respondents from PBOS reported that their employees were more committed to the projects than to the company. It was found that all respondents be-

TABLE 3   Actual usage of ICT tools in the two forms of organizations

Technology	TO	PBO
Intra-organizational		
Intranets	60% using, 13% rejected	90%
Design and planning	2D CAD 70%, 3D CAD 60%	2D CAD 100%, 3D CAD 80%
Scheduling	40%, simple or home-made software	100%
Inter-organizational		
Extranets	24%	50%
E-Procurement	43%, advanced use low	45%, increase in future
Collaborative platforms	No data	50%
Document management	19%, mostly internal	100%
Customer relationship management	37%	90%

lieved in written contracts as being essential to project business. Of the usage of 3D design software, the Finnish house building firms that used 3D software used mostly Vertex BD (ten out of 16). The use of e-procurement is confusing, as 43% acknowledged they used it but mostly in the form of non-true e-procurement such as e-mail documents or attachments. The most common form of e-procurement was proprietary software provided by the supplier that accounted for 4% of the procurement of materials.

Conclusion

The main point of this paper is that different organizational forms required different approaches for applying communication tools. We have elaborated on the main differences between project-based organizations and traditional organizations, e.g. varying time-frame, complexity of collaboration, and knowledge reapplicability. PBOs are more complex than traditional organizations in respect to number of partners and activities, hence they require more emphasis on how to support and simplify the communication. Because project teams, although small, belong to bigger organizations, they have access to more tools and other resources than a traditional organization of the same size as the project team, which will skew the IT complexity issues to favour the project teams. The over-belief in quantifiable measures of IT adoption has to be taken into account. In order to successfully apply e-communication tools, the organization has to look to the available tools and find the one that fills its communication need.

As the project-based organizations conduct several projects with multiple partners, the inter-organizational communication requirements are higher than for traditional organizations where inter-organizational communication is carried out vertically. In SMES, employees have easy access to communicate with the head of the company; however, in the MNCS, there is some 'distance' between the chief executive officer (CEO) and project managers.

PBO may communicate with advanced communication systems due to the skills and knowledge involved in different projects. The technologies available to both TO and PBO might be the same but the knowledge and familiarity with new technologies might differ, as PBOS are often more change-oriented and exposed to the technologies in their inter-organizational relationships. Traditional organizations do not need to collaborate with many firms in different constellations, therefore the need to communicate does not need to be as dynamic and learning-intense as the PBOS that form many relationships and participate in project collaboration efforts where the technology solution involved may change as the group of collaborators changes or a new project is formed. This is more apparent at the inter-organizational level.

The characteristics of the firms, whether they are TO or PBO, are related to the form of organization. The communication needs of TOS and PBOS are connected to the inter-organizational and intra-organizational relationships exhibited, where more dynamic and different relationships externally might provide firms with differing communication needs. The adoption of ICT is restricted to the available technologies, communication needs and organizational characteristics of the organizations, giving differing actual use of ICT between PBOS and TOS.

The contribution of this paper is towards the understanding of the differences in nature and communications of the traditional and project-based organizations. We emphasise the fact that project-based organizations make more interfirm collaboration efforts, thus requiring more extensive communication systems for inter-organizational linkages. Time is a crucial factor in PBOS, due to heavy penalties on delays. On the other hand, the ever-changing collaborations in PBO also prohibit the full efficiency of using the same system each time, as the project team – if consisting of several organizations – is of a different aspect.

Further research is needed to measure the wider aspects of differences in e-communication adoption, since our sample of PBOS as well as TOS is quite small and we cannot claim statistical accuracy.

The barrier aspect is a further issue that could be incorporated in future research as to whether PBOS and TOS exhibit different forms of barriers and the ability to overcome these. We believe the study would also benefit significantly from doing more extensive qualitative investigations on the reasons for adopting different forms of e-communication.

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