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From Traditional to Virtual Organisation: Implications for Work Unit Boundaries

Christopher J. Hemingway

Information Systems Research Centre, Cranfield School of Management

Cranfield, MK43 0AL, United Kingdom

Tel. +44-1234-751122, Fax. +44-1234-752641

c.j.hemingway@cranfield.ac.uk

Karin Breu

Information Systems Research Centre, Cranfield School of Management

Cranfield, MK43 0AL, United Kingdom

Tel. +44-1234-751122, Fax. +44-1234-752641

k.breu@cranfield.ac.uk

Abstract

Boundary and virtual organisation theory were used to study the implications of organisation level virtualisation for work units. A single case study in a geographically dispersed public sector organisation revealed multiple implications of the coexistence of traditional and virtual work units. Different quality ICT access for traditional and virtual work units was found to result in conflicting expectations about the speed of information sharing. Exclusive reliance on time-based performance measures to control the allocation of staff to virtual work units compromised knowledge sharing, whilst virtual team arrangements and poor formal knowledge capture simultaneously increased workers' dependence on informal exchanges. Although the fragmentation of knowledge that resulted from the virtual work arrangements threatened operational performance, there was no evidence of mitigating initiatives. The research contributes to the currently limited understanding of the virtualisation process by proposing an empirically derived framework for analysing the challenges emerging from the coexistence of traditional and virtual work units. The proposed framework correlates the networking, restructuring and organisational learning aspects of the virtualisation process with their implications for interfaces, permeability and boundedness of work units. The findings are also of interest to practitioners in traditional organisations seeking to exploit the potential of virtual organisation.

Keywords

Information sharing, knowledge management, organisation restructuring, virtual organisation, work unit boundary

1.   Introduction

Organisations face ongoing pressures to become more flexible and responsive to change, looking increasingly to virtual organisation to reduce organisational slack, facilitate continuous learning, and capitalise on core competencies. When traditional organisations adopt virtual organisation, they undergo a transition period, where traditional structures coexist, and sometimes conflict, with virtual

arrangements. In assuming, for example, that employees engage freely in lateral communication and make decisions independently, a virtual model of organisation can potentially undermine traditional structures and communication practices before they are fully replaced. In this paper, we refer to this process as virtualisation (Orlikowski & Schultze, 2001).

At the work unit level, studies have focused on the internal dynamics of, for example, distributed communities-of-practice and virtual teams. Little is known, however, about the interplay between traditional and virtual work units during virtualisation. This presents a gap in current understanding of how virtualisation is achieved in practice and the reasons for the success or failure of virtualisation initiatives. Boundary theory, which analyses work unit interactions, offers potential insights but is uncommon in organisation studies generally and virtual organisation in particular (Yan & Louis, 1999).

The aim of this paper is to extend current conceptions of work unit boundaries to the analysis of the transition from traditional to virtual organisation. The paper is structured as follows. A review of social scientific boundary theory and virtual organisation is presented in section 2, followed by a description of the research method in section 3. Section 4 presents the empirical findings from the case study. Section 5 discusses the findings, with a particular view to analysing the interdependencies between work unit boundary and virtual organisation activities. Section 6 presents conclusions and directions for future research.

2.   Literature Review

Concepts such as economy, industry, supply chain, organisation, department and work unit all imply the existence of boundaries. Some boundaries are more discernible than others, especially when social boundaries coincide with physical boundaries. For instance, the boundary of a firm that houses all its assets, resources and employees within a single building, is easily identifiable. Regardless of type, a boundary determines what counts as 'within' and 'beyond'. Boundary analysis is particularly useful for understanding virtual and ICT-based organisation forms and working models as they often displace boundaries and redefine their meanings (Hinds & Kiesler, 1995).

2.1. Work Unit Boundaries

A work unit refers to any "suborganisational entity composed of multiple individuals performing certain organisational tasks" (Yan & Louis, 1999, p.26). Examples of work units include project and management teams, departments and committees. Although the boundary literature mainly focuses on formal work units, this paper addresses both formal and informal types. Informal work units are considered because, when groups of people participate in informal interaction, boundaries inevitably emerge between participants and non-participants (Krackhardt, 1994). Informal units do not exist in isolation but interact with other informal and formal work units (Wenger, 1998).
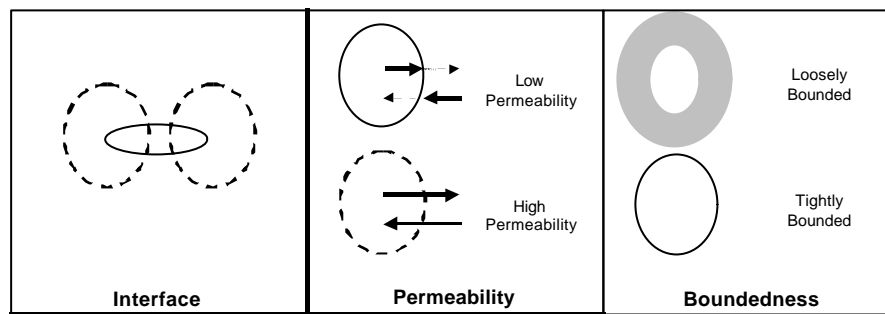
Figure 1*: Three key boundary attributes.*

Relationships between work unit boundaries have been characterised using three attributes (Figure 1). The *interface* depicts the interactions that occur at the boundaries between work units (Brown, 1983). An interface between two work units may arise from the need to accomplish a shared task or simply due to the physical proximity of work units.

Permeability is the extent to which information and resource flows across a boundary are regulated. Where information and resource flows are constricted, a boundary has low permeability; where they are unconstricted, permeability is high (Brown, 1983). Permeability can vary between types of information and resources. For example, historical information often flows more freely across work unit boundaries than information about future strategy. It is also common to find that inward information and resource flows are less constrained than outward flows (e.g. Schultze & Boland, 2000).

Boundedness refers to the degree of definition of social boundaries. A tightly bounded work unit has a readily identifiable membership and the members have strong associations with each other and with the work unit. Tightly bounded work units may inhibit organisational integration, whereas strong pressures for organisational integration may threaten work unit boundaries (Schneider, 1991). For a loosely bounded work unit, membership is not clear and the strength of association between members is weak. In some cases, the ties between members become so weak that a work unit becomes underbounded and may, consequently, cease to exist (Alderfer, 1980).

2.2. Work Unit Boundary Activities

Three types of boundary activity are identified in the literature: buffering, spanning and bringing-up (Yan & Louis, 1999). *Boundary buffering* refers to activities that close off a system from its environment. In a work unit, 'sentries' buffer activities, influencing the permeability of its boundary (Ancona & Caldwell, 1988). Buffering activities include quality control on incoming resources and information as well as the censoring and directing of outgoing flows.

A work unit boundary can be the location of *boundary spanning* interactions between members and non-members. An interface emerges where spanning activity is between two work units. Boundary spanning activity may be undertaken by 'ambassadors' who work in the wider organisation to acquire information, resources and support (Ancona & Caldwell, 1988, 1992). For formal work units, spanning may be facilitated by formal structures and channels, although informal boundary spanning utilising the personal networks of work unit members has also been observed (Krackhardt, 1994).

There are two types of *bringing-up* activities. *Focalisation* activities concern the shaping of a collective vision, rituals for recognising and rewarding progress, and adapting ICTs and the physical work environment to work unit activities (Smith & Comer, 1994; Boland & Tenkasi, 1995; Yan & Louis, 1999). *Identity creation* activities involve creating an internal working climate that is more supportive of members than the external climate, giving them a sense of security and mutual respect.

2.3. Work Unit Boundaries and Virtual Organisation

The process of virtualisation is seen to entail three interdependent activities: networking, restructuring, and building a learning organisation culture (Dutton, 1999).

Networking is the use of ICTs to improve the efficiency of, and potential for, gathering and sharing information (Dutton, 1999). ICTs are used to span geographical and functional boundaries and to increase connections between employees, helping to create more usable organisational knowledge (Robey, Boudreau & Rose, 2000). Intranet (internal to employees), extranet (accessible to customers and/or business partners) and Internet (public space) sites extend work unit and organisational boundaries into the virtual space.

Restructuring uses networking opportunities to enable more complex organisational forms, which offer greater operational and cost flexibility (Miles & Snow, 1992). Restructuring may include changes in vertical and horizontal coordination, organisation and work unit composition, and changes to inter-organisational coordination (Fulk & DeSanctis, 1995; Lucas & Baroudi, 1994). Changes in coordination and control imply changes in boundary activities, which can positively or negatively affect work unit performance (Eppler & Sukowski, 2000).

Finally, virtual organisation requires the development of a *learning organisation culture*, whereby knowledge is shared across cultural as well as time-space boundaries (Yap & Bjorn-Andersen, 2002). The frequent creation and disbanding of work units increases the need for a learning and change capability, which requires all employees to learn and share learning (Orlikowski & Schultze, 2001). Virtual work units may require changes to traditional reward systems and membership selection processes that assume a fixed organisation (Lurey & Raisinghani, 2001).

2.4. Research Questions

Virtualisation requires an organisation to undertake significant changes to its work units and the interactions between them. Current research into virtual organisation, however, has paid little attention to the transition from traditional to virtual forms of organisation. To address this gap in understanding, this study framed the following research question:

- What are the implications of organisation-level virtualisation processes for work unit boundaries and activities?

- Is work unit boundary theory applicable to the analysis of virtualisation processes?

- What are the implications for ICT usage of the co-existence of traditional and virtual work units?

3.   Research Method

Given the immature state of theory development in the transition from traditional to virtual organisation, the study employed a case study methodology (Eisenhardt, 1989). Multiple sources of

data collection were used in order to provide some opportunity for triangulating results. The primary method of data collection was semi-structured interviewing. Interviews were recorded and verbatim transcripts produced. Non-obtrusive observation was used to obtain authentic indications of interactions in the work units in change. In addition, relevant documentation on the structural and procedural changes in the case study organisation was collected.
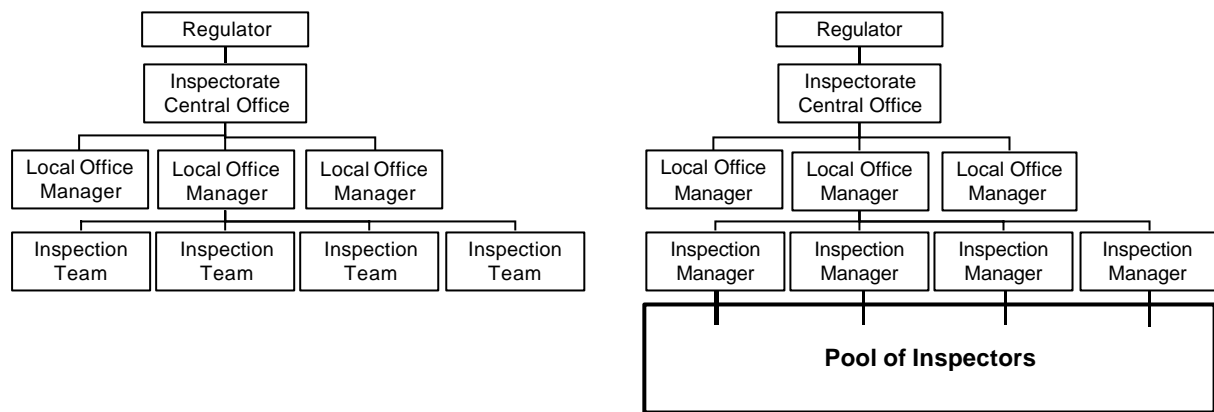
All data were analysed using grounded theory methodology as it provides a systematic process for theory-building (Strauss & Corbin, 1990). Categories emerging from the data were specified in terms of the conditions and context in which they arose, the actions and interactions of the actors involved, the strategies and tactics employed by the actors, and the consequences of actions, interactions and non-actions. Categories were then compared with existing boundary and virtualisation theory and their potential for explaining virtualisation processes at the work unit level was assessed.

The empirical research was undertaken in Inspectorate (a pseudonym), a public sector agency responsible for conducting inspections of public sector organisations under the direction of a governmental body, Regulator (a pseudonym). Data collection took place in May 2001 and consisted of a detailed study of a Local Inspectorate Office and a broader study of Inspectorate as a whole. At the local office worked a local manager, four inspection managers, seven senior inspectors, 18 inspectors and three trainee inspectors. A total of seven in-depth, semi-structured interviews were conducted with the local office manager, one inspection manager, two senior inspectors and three inspectors. One focus group interview was undertaken with members of an inspection team based at the local office, consisting of an inspection manager, a senior inspector, two inspectors and a trainee inspector. The interview sessions, ranging from 60 minutes for individual interviews to three hours for the group interview, were recorded. Verbatim transcripts were produced and, prior to data analysis, were administered to interviewees for validation. The broader study of Inspectorate included the analysis of documents describing changes to its internal organisation and inspection services, and around 20 hours of direct observation of internal meetings.

4.   Changing Boundaries in a Public Sector Organisation

4.1   Inspectorate's Traditional Organisation Structure

Inspections follow systematic procedures and comply with statutory requirements set by Regulator, which is reflected in Inspectorate's bureaucratic organisation structure. In the mid-1990s, Regulator's direct control over Inspectorate was replaced by an "ownership-market relationship". The 'ownership' component is reflected in Regulator's authority over policy and procedure changes. The 'market' component is reflected in the new requirement for Inspectorate to compete against private sector organisations for inspection projects. Although the operational conditions for Inspectorate had changed, its organisation structure remained unaltered (Figure 2a).

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        ┌──────────────┐                                    ┌──────────────┐
        │   Regulator  │                                    │   Regulator  │
        └──────┬───────┘                                    └──────┬───────┘
        ┌──────┴───────┐                                    ┌──────┴───────┐
        │ Inspectorate │                                    │ Inspectorate │
        │ Central Office│                                   │ Central Office│
        └──────┬───────┘                                    └──────┬───────┘
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Figure structure (a): Regulator → Inspectorate Central Office → Local Office Manager, Local Office Manager, Local Office Manager → Inspection Team, Inspection Team, Inspection Team, Inspection Team

Figure structure (b): Regulator → Inspectorate Central Office → Local Office Manager, Local Office Manager, Local Office Manager → Inspection Manager, Inspection Manager, Inspection Manager, Inspection Manager → **Pool of Inspectors**

Figure 2*: (a) Original structure of Inspectorate and (b) impact of virtual organisation*

Under the traditional structure (see Figure 2a), inspections were conducted by inspection teams, consisting of an inspection manager and between six and ten inspectors of varying expertise, from trainee to senior inspector. Each inspection team was geographically distributed with members working at multiple client sites. A team inspected the same clients every year, thereby gaining intimate knowledge of their cultures, structures and operations, which helped them to conduct inspections efficiently. The need for team learning was low, as each inspection team was allocated a set of similar clients so that they needed to learn only about changes to inspection procedures. Inspection managers spent around a quarter of their time at the local office and the remaining time at client sites to monitor progress, provide technical advice to junior inspectors and liaise with client organisations' senior staff.

4.2. Virtualisation of Inspectorate's Organisation Structure

In the late 1990s, government pressures for inspections to become competitive was so intense that Inspectorate could no longer maintain its traditional structure. A key response to cost pressure was to introduce 'billable hours', i.e. the number of hours billed to clients as a measure of inspector performance. Inspections subsequently became more stressful, as the findings of a national employee satisfaction survey confirmed.

> Stress is a big one. Unrealistic targets. Too many targets. Too many unrealistic deadlines. (Senior Inspector 2, manager of the survey)

To reduce organisational slack, and thereby increase cost efficiency, Inspectorate's senior management decided to unbundle the permanent inspection teams. Most of the organisation hierarchy would remain unchanged, but inspectors – the majority of the field workforce – would be 'detached' from the structure and treated as a "resource pool" (Figure 2b). Projects would be assigned to inspection managers who resource temporary virtual teams from the pool to last for around three months, so inspectors would now work for multiple inspection managers throughout the year.

The virtual team structure altered interactions between inspectors. The reduced slack time and increased mobility of inspectors, both geographically and between teams, disrupted conventional ways of sharing technical and client knowledge. In addition, greater utilisation of inspector time, introduced by the resource pool model, largely removed opportunities for inspectors to work at local offices, thereby reducing chance encounters with colleagues.

> You can now go for months on end without seeing someone [outside of your inspection team]. You can email them or talk to someone on the phone but it isn't the same. (Inspector 1)

4.3. Inspection Teams and Client Knowledge

Under the traditional structure, client knowledge was predominantly informally shared within inspection teams. The permanent team membership and client group model of the past was considered to have worked well, even though the inspection team met infrequently. Team members could readily judge when new client knowledge needed to be shared with the inspection manager or to team members. Because informal sharing of client knowledge between inspectors worked so well, inspectors never maintained Client Reference Documents (CRDs), although this was officially required.

In the new organisation, where inspectors no longer worked in permanent teams and stable client groups, the shared client knowledge base among inspection team members was instantly dispersed.

> When I went to [client name] – I'd never been there before – because John, the inspection manager, wasn't there, I didn't get the information on the place. I didn't know who did what. I was always having to ask [colleague's name] who did what, what was going on. (Inspector 1)

Inspectors were now encouraged to read the CRD before visiting a client site, whilst inspection managers, as the only permanent client contact, became solely responsible for compiling CRDs. Inspectors, however, found that CRDs, out of date and incomplete, were an unreliable client knowledge source, as inspection managers were unable to commit sufficient time to maintaining them.

> The CRD should put inspectors in the picture. The problem is we've got some stupid deadlines and, as a result, the CRD just goes. (Inspection Manager 2)

If nobody in a team of inspectors had current knowledge of the client, inspectors who had previously worked with the client could, theoretically, be contacted using mobile ICTs. Yet, in practice, inspectors regarded it as intrusive and inappropriate to contact previous colleagues whilst they were at client sites.

> Most people are accessible one way or the other. But your time must be dedicated to your client. (Inspector 5)

The lack of access to up-to-date client knowledge, created by the virtual organisation, was most problematic for junior inspectors. In absence of long established working relationships, they felt they had least opportunity to obtain client knowledge from senior colleagues, as the sharing of sensitive client knowledge, particularly via ICTs, presupposed good working relationships based on mutual trust. As inspection managers were the focal point for client knowledge under the virtual team model, frequent movements between teams were described as inhibiting the development of trust relationships with junior inspectors.

> It's often confidential, so it can't be freely shared. I'm certainly not going to put it in an email or electronic memo. (Inspection Manager 1)

> This [sharing client knowledge] is very dependent on how close the relationship is between the inspection managers and the inspectors. Unfortunately, you lose the relationship when you move from project to project. (Inspector 4)

Project progress in inspections was monitored by a central administrative function. Whilst the office-based administrators had permanent access to email, the corporate intranet, electronic client and technical documents, inspectors working from client sites, had only very limited electronic access. As a result, they needed more time than provided to co-ordinate inspection progress reports.

> They are forgetting that we are sitting in client offices with one voice grade telephone line and that we're not necessarily going to be able to log on. The time frame you get for responding to things has become ridiculous. I have to do a monthly progress report to the Centre and I initially had two weeks. Now, I'm lucky if I get that email on Friday afternoon and I'm supposed to make the progress report by Tuesday lunchtime. A lot of that requires collecting information and talking to people at each site. (Inspection Manager 2)

4.4.   Inspection Teams and Technical Knowledge

Inspectors are educated at university and receive on-the-job training, similar to an apprenticeship. Under the permanent team structure, an inspection manager or senior inspector would mentor a trainee over three years. Under the virtual team structure, trainees started to move between teams and, thus, change mentors accordingly. Although there was no corporate policy for managing trainees under the virtual model, the local office developed its own procedure for handing over trainees between mentors:

> The way we do it is you do your first job and then do an extra one, so you've built on that. And then, when they go on to work with one of the other managers, they go with a list of what they can do and what they've done. (Local Office Manager)

Inspectors depended on technical documentation for their day-to-day work. Although these were available in electronic form and accessible remotely, inspectors preferred to use hard copies at client sites because of the poor electronic access in the field. Office-based technical experts, however, increasingly insisted on using electronic documents and stopped providing printed versions, making it difficult for staff to access up-to-date technical information:

> The Blue Book used to be very useful. It was like an encyclopaedia. Specialists made sure that whenever new procedures came out, it would be updated. If you needed to know what an earth they meant by [technical term], the Blue Book would tell you. We need that basic tool but it doesn't exist any more. (Senior Inspector 3)

5.   Discussion

Understanding the transition from conventional to virtual organisation requires an examination of the relationships between organisation level changes, described in terms of virtualisation activities, and changes to the organisation's working arrangements, described in terms of work units' boundary properties and activities. An empirically derived framework mapping out these relationships in Inspectorate is presented in Table 1.

Virtualisation Activities

	NETWORKING	RESTRUCTURING	LEARNING ORGANISATION
INTERFACE	Different levels of access to electronic channels lead to diverse expectations about the speed of information sharing between office-based and field staff.	Increased time utilisation reduces opportunities for knowledge sharing between inspectors across inspection teams.	Work units preferring electronic technical documents stop maintaining paper versions, reducing the sharing of up-to-date technical information.
PERMEABILITY	Concern about client perceptions limits the use of ICTs for sharing client knowledge.	Client knowledge no longer contained within inspection team boundary but becomes diffused across the pool of inspectors.	Client documents not maintained. No support for capture and sharing of client knowledge in response to high permeability of virtual teams.
BOUNDEDNESS	Near absence of opportunities to develop trust relationships inhibits sharing of confidential client information via ICTs.	Contact with colleagues in other inspection teams becomes more useful. Contact with members of own team becomes relatively less useful.	Inspectors no longer trained in single work unit. Evolution of local practices for handover of trainees between inspection managers.

(Left margin label: Work Unit Boundary Properties)

Table 1: *Implications of virtualisation activities for work unit boundaries. Framework developed from Dutton (1999) and Yan and Louis (1999)*

5.1. Networking

Networking, as defined by Dutton (1999), is the use of ICTs to span organisational and work unit boundaries to reduce the spatial and temporal constraints on communication and collaboration. Researchers have observed that, with virtual organisation, "a greater speed of response becomes the standard business expectation" (Cooper, 1999, p.116). In the case of Inspectorate, office-based workers were permanently on-line and expected that communication among a distributed workforce should be instantaneous. Yet, as field workers had only restricted on-line access to corporate ICT systems, they expected little change in the speed of communication with office-based colleagues. Inspectorate's failure to surface and address differences in expectations meant that networking did not readily translate into more effective boundary spanning at the *interfaces* between traditional and virtual work units. This finding adds to previous research, which identified in non-virtual contexts that ICTs can inhibit communication across the interfaces between traditional work units (Newell, Scarborough and Swan., 2001).

Although technical limitations were apparent, mobile ICTs offered the potential for inspectors to communicate regardless of location. This networking capability was scarcely exploited due to social constraints on the *permeability* of work unit boundaries. In particular, inspectors, who spent most of their time at client sites, were reluctant to use mobile email, Internet and telephone to communicate with colleagues as they believed this would meet with clients' disapproval. Consistent with previous research, this finding confirms that the exploitation of networking to increase the connectedness of an organisation is determined by both technical factors and the social context of technology in use (Orlikowski, 2000).

The reduced opportunities for inspectors to build relationships of trust with team members was one factor that accounted for the virtual teams' lower *boundedness* relative to the permanent teams'. Building trust usually requires extensive face-to-face interaction and joint socialisation (Nonaka & Takeuchi, 1995). Junior inspectors had few opportunities to build trust with senior colleagues who, consequently, were reluctant to share confidential information via ICTs. In this way, the reduced boundedness of virtual teams inhibited the use of mobile ICTs for sharing client information.

5.2.   Restructuring

To achieve the financial benefits of virtual organisation, the *interface* between resource pool and inspection teams was tightly controlled by allocating inspector time to projects. Minimising 'slack' time at the work unit level reduced inspectors' opportunities for boundary spanning activities (e.g. communicating with colleagues), although they were essential for sharing client knowledge across teams. The tight control of time allocation to work units was also reported to increase stress. Previous research has found negative impacts of an excessive control of work unit interfaces, including "frustration and demotivation due to a lack of sufficient team autonomy" (Eppler & Sukowski, 2000, p.340). Organisations undertaking restructuring should, therefore, consider its implications for work unit motivation and performance.

The defining characteristic of permanent teams was their accumulation of intimate knowledge of client sites and contexts. In contrast, the boundaries of virtual teams were highly *permeable* to client knowledge, with inspectors frequently moving between projects and clients, leading to the fragmentation of client knowledge across the resource pool. This compromised Inspectorate's ability to match team knowledge with client needs, creating a great need for informal knowledge sharing across inspection teams, which the tight control of work unit interfaces had removed. Virtualisation, thus, compromised competitiveness by failing to support the informal collaboration between work units, which is essential for filling the gaps in formal systems (Ancona & Caldwell, 1992).

Under the permanent team model, inspectors experienced communication with their team members as highly valuable, as all of the client knowledge required for inspections was held within the team. In contrast, the virtualisation model required client knowledge to be sought from inspectors across the resource pool, which served to reduce the value of communication within the team. Thus, in addition to the reduced opportunity for developing trust relationships, the fragmentation of client knowledge further contributed to reducing the *boundedness* of virtual teams.

5.3.   Developing a Learning Organisation Culture

This case study illustrates how a lack of attention to organisational learning can limit the benefits of virtualisation. Traditional, office-based work units assumed that ICTs would achieve faster information sharing across the *interfaces* of all work units and were unaware of the communication and coordination challenges facing virtual work units. As a result of this assumption, traditional work units ceased supporting printed technical information, even though virtual work units lacked the ICT facilities to rely exclusively on electronic information resources. Thus, in terms of the co-existence of traditional and virtual work units, Inspectorate failed to develop the organisational learning capability to observe its own actions, experiment to discover the effects of alternative actions and modify its actions to improve performance (Fiol & Lyles, 1985; Robey, et al., 2000). Moreover, irrespective

of the role of ICT in sharing explicit knowledge, the reduction of slack time deprived field staff of opportunities for sharing tacit knowledge, which requires face-to-face interaction (Wenger, 1998).

Staff recognised the need for more effective knowledge sharing in order to compensate for the greater *permeability* of inspection team boundaries to client knowledge. Strict performance measures, however, made it difficult for inspection managers to commit time to documenting client knowledge, even though there was a greater need for client documents under the virtual model. In the absence of formal knowledge capture, informal sharing of client knowledge across work units became essential to compensate for the fragmentation of client knowledge. Yet, no organisational responses to the problems of lack of trust, poor ICT access and lack of opportunities for knowledge sharing were evident. In other words, the effects of fragmenting client knowledge were not mitigated by initiatives for integrating knowledge through learning (Crossan, Lane and White, 1999).

The reduced *boundedness* of virtual inspection teams had significant implications for the development of trainees, who would no longer learn from a single mentor. An illustration of efforts to manage the learning challenges of virtual organisation through improvisation was the local office's evolution of local practices for handing over trainees between mentors. Although bottom-up innovations at the sub-organisational level make an important contribution to developing a learning organisation, their full benefits are achieved through integrating these learning processes organisation-wide (Crossan, et al., 1999; Robey, et al., 2000). In the case of Inspectorate, however, organisational level processes to facilitate learning in a hybrid traditional-virtual environment were not in place.

6.   Conclusions and Future Research

This paper used a single case study to illustrate how boundary theory can be used to analyse the transition from traditional to virtual organisation. Relating organisation level virtualisation activities to boundary changes at the work unit level revealed numerous implications: (a) social constraints on networking (column 2, Table 1); (b) the knowledge sharing implications of restructuring to improve cost efficiency (column 3, Table 1); and (c) the inefficiencies arising from a neglect of organisation-level learning processes (column 4, Table 1). The research contributes to the currently limited understanding of the virtualisation process by proposing a framework for analysing the challenges emerging from the coexistence of traditional and virtual work units. The proposed framework correlates the networking, restructuring and organisational learning aspects of the virtualisation process with their implications for the interfaces, permeability and boundedness of work units.

In general, single case study research designs pose methodological limitations because of the narrowly defined sample characteristics. This research was undertaken in a geographically dispersed public sector organisation and investigated the coexistence of traditional and virtual work units. One requirement for future research, from this perspective, would be to extend the sample to private sector organisations to clarify whether variations can be expected in diverse contexts. In addition, our case organisation represents a partially virtual organisation. Another requirement for future research is, therefore, to elicit, by way of comparative analyses, whether variations in boundary dynamics exist in fully virtual as opposed to partially virtual organisations.

The findings from this research also offer opportunities for further work on the specific topic of virtualisation. The design of technology systems, as found elsewhere, inherently creates and/or

reinforces boundaries. Depending upon specific system design choices, these boundaries can be functional, geographical or temporal but also constitute usage boundaries due to individuals' varying levels of knowledge and ability to use available technologies and systems. For instance, in our case, technology introduced new boundaries between office-based and mobile workers as a result of variations in the accessibility of the organisation's communication and knowledge systems. When ICTs are used to support organisation-wide knowledge sharing across boundaries, this may conflict with individuals' personal desires to preserve boundaries that are meaningful to them. For instance, research has found that informal communities of practice and people's personal networks represent boundaries that do not typically correspond with the boundaries that a given knowledge system might create (Pan & Leidner, In press). Future research in this area, therefore, needs to ascertain how to design systems that, whilst delivering a given organisational knowledge management objective (e.g. organisation-wide best practice transfer), do not compromise informal boundaries (e.g. at the level of communities of practice) that are fundamental to leveraging an organisation's strategic knowledge.

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