Barrier impact on organizational learning within complex organizations

Stephen McLaughlin, Robert A. Paton and Douglas K. Macbeth

Abstract

Purpose – The purpose of this research is to examine the manner in which employees access, create and share information and knowledge within a complex supply chain with a view to better understanding how to identify and manage barriers which may inhibit such exchanges.

Design/methodology/approach – An extensive literature review combined with an in-depth case study analysis identified a range of potential transfer barriers. These in turn were examined in terms of their consistency of impact by an end-to-end process survey conducted within an IBM facility.

Findings – Barrier impact cannot be assumed to be uniform across the core processes of the organization. Process performance will be impacted upon in different ways and subject to varying degrees of influence by the transfer barriers. Barrier identification and management must take place at a process rather than at the organizational level.

Research limitations/implications – The findings are based, in the main, on an extensive single company study. Although significant in terms of influencing both knowledge and information systems design and management the study/findings have still to be fully replicated across a range of public and private organizations.

Originality/value – The deployment of generic information technology and business systems needs to be questioned if they have been designed and implemented to satisfy organizational rather than process needs.

Keywords Supply chain management, Knowledge transfer, Learning organizations

Paper type Research paper

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Introduction

An organization's supply chain capability is now regarded as a key contributor to any organization striving to maximise competitive advantage (Troyer, 1995). No longer is the ''supply chain'' simply the preserve of procurement, logistic, or manufacturing specialists (Porter and Millar, 1985). Organizations are waking up to the fact that the supply chain is not simply a support function for its business, but is in fact the key capability against which a competitive advantage can be developed (Kulp *et al.*, 2003).

Organizations, in general, are now well aware of the components that make up their supply chain, indeed these components are often well established and embedded, however, many still struggle with the problem of effective component alignment (Day, 1994; Teece, 1998). Functionally aligned organizations may understand and individually manage the supply chain components, but, performance can only be maximised once they achieve the transformation to process alignment. Process aligned organization focus on core process performance as opposed to functional business unit performance. This is a fundamental and key change for most organizations and one that they must make in order to fully develop their supply chain capabilities (Van Weele, 2002). However, this shift in focus does not come easily to many organizations, as internal business unit boundaries can be difficult to remove. The problem is exacerbated within complex organizations where capabilities such as

manufacturing, logistics, and procurement have been outsourced. The alignment of these core components becomes all the more difficult as external business boundaries such as organizational, technological, and people barriers need to be negotiated and managed (Barson *et al.*, 2000).

As the performance of core supply chain processes are vital to the overall success of the supply chain, and therefore, the overall success of the organization, how barriers impact along core processes needs to be understood. It is no longer sufficient to know how barriers impact, in general terms, across the whole organization, or, indeed how particular functions may respond; senior management needs to understand how barriers impact at different stages along core processes. The core business process, irrespective of where in the organization it operates, is in effect a core information/knowledge highway. Identified barriers will impact upon how information is accessed and shared, and also upon how knowledge is created and managed. If innovation and organizational learning are valued within the organization then consideration must be given to how barriers impact across an organization's ''arterial'' business processes.

This paper, which stems from on-going research, looks at a core supply chain process within IBM and identifies barriers that are impacting performance. However, the type and impact of the barriers can be seen to vary along the core supply chain process. This, in effect, identifies different information and knowledge creation and sharing practices across the organization.

Research context

This paper investigates how knowledge and information are created and shared, from a process alignment perspective, within a complex organisation. In particular it examines IBM's Integrated Supply Chain (ICS). The paper focuses on identifying and discussing the barriers that impede the knowledge creation and transfer process and as such may be seen as part of a wider, ongoing, major research initiative. An initiative, originating within IBM, that is particularly interested in the way organizations view the inter-connected relationship between information technology (IT) and knowledge systems, people, process, and the prioritisation of change through an integrated decision-making process.

As indicated earlier, this paper deals with the initial phases of a research initiative associated with a far wider project being undertaken by the principle author as part of an ongoing IBM project supported and supervised by external researchers. In order to understand how information and knowledge are created and shared along processes within a complex organization the principle author looked to his own personal experience within IBM's ISC organization. Although the author is a manager within the ISC organization the research conducted also formed the basis for the author's doctoral research (undertaken on sabbatical from IBM), which in turn is part of an inter-disciplinary, and multi-sectoral research initiative coordinated by the co-authors. As there is little academic research on actual barriers to information and knowledge transfer along process pathways the author relied on his pre-understanding (Gummesson, 1991) of the process and organization as a valid starting point for conducting this research. Objectivity and academic professionalism was maintained by the need to conform to the rigours of an ESRC recognised doctoral programme, as well as the requirement to engage with on going research initiatives.

Ultimately the aim is to develop an underpinning theory and associated models relating to improving process performance in complex organizations. The research is exploratory in

"**Process aligned organizations focus on core process performance as opposed to functional business unit performance.**"

nature and a Case Study (Yin, 2002) methodology is being used to support this line of inductive theory building. The research and analysis outlined in this paper has been conducted using qualitative and quantitative methods with all data gathering complying with validation criteria as outlined by Yin (2002).

How the information and knowledge transfer barriers manifest themselves along IBM's core supply chain processes will form the base case on which the authors will look to develop an inductive emergent theory. As said earlier the research outlined in this paper only covers part of the overall research project. The author will validate the findings from the IBM case with other complex organizations, drawn from across both the public/private sectors and across the service/manufacturing divide, in order to finalise on an emergent theory.

Delivering knowledge throughout an organization

To ensure the success of any knowledge management initiative an organization must develop within their employees a desire for knowledge (Quinn *et al.*, 1996). According to Kluge *et al.* (2001) if a knowledge program is to be embraced by the workforce every individual needs to be thirsty for knowledge. The employee should see knowledge management (KM), or to be precise the active application, distribution and cultivation of knowledge within the organization as a whole, as a fundamental part of their personal success and satisfaction.

The emphasis on the importance the individual plays in the creation and sharing of information and knowledge is a widely supported view (Krogh *et al.*, 2000, Kluge *et al.*, 2001). Therefore, if one accepts the importance of information access and sharing, and knowledge creation as part of an organizations ability to learn and be innovative (Krogh *et al.*, 2000, Davenport, 2005) then the interaction individual employees have on core processes will have significant impact on process performance.

In order to develop a ''learning'' mentality within the organization a knowledge, or information ''pull'' culture needs to be encouraged over a knowledge, or information ''push'' culture. An important aspect of the knowledge or information ''pull'' delivery mechanism, is that it focuses heavily on the softer aspects of management and as a result a lot of organizations fail to engage in successful ''pull'' and miss out on the benefits of a ''bottom-up'' knowledge delivery system (Kluge *et al.*, 2001).

Identifying barriers to knowledge creation and sharing

The academic and practitioner literature relating to barriers likely to impact, or impede, attempts to enhance process performance through more effective and efficient KM initiatives, is both extensive and varied. Researchers and authors have approached the issue of barriers to information and knowledge transfer from many different perspectives. The principle author has reviewed this literature with the aim of creating and defining an agreed set of common barriers and/or inhibitors. By way of validating the list the research of the principle contributors to process related transformation, in particular as it relates to barriers/inhibitors, has been summarised from the following perspectives.

1. *Motivation to share knowledge.* Kluge *et al.* (2001) identify two main barriers to developing a knowledge creating and sharing culture. The barriers are:

- *Not invented here . . .* The ''not invented here'' syndrome describes the tendency to neglect, ignore or, worst still, disparage knowledge that is not created within an individual's sphere of interest. This problem can arise from a genuine mistrust of external knowledge sources.

- *Knowledge is power . . .* The ''knowledge is power'' syndrome refers to a mindset that places the values of knowledge to the individual ahead of its value to the company. At its most basic, knowledge sharing starts by taking the time to help others. In a successful company there is always time pressure but the extra 10 minutes spent with a colleague explaining something will be repaid later. However, just as people distrust external knowledge, they also see their own knowledge as a part of their personal competitive advantage. McKinsey's ''Corporate Prisoner Dilemma'' illustrates this point very well, which is a modification of game theory's prisoner dilemma. Figure 1 demonstrates the corporate prisoner dilemma.

  From the figure we can see that the ideal solution is for employee A and B is to share knowledge as this is where the most significant gains maybe expected. However, if one decides to hoard knowledge whilst the other shares knowledge then the power balance is shifted in favour of the employee who hoards. As no employee wishes to be taken advantage of, or if the culture is one where individual performance is rated above team performance, the expected behaviour will be one where both employees will hoard. This will maintain a status quo where employees are keen to ensure their personal competitive advantage is not eroded. That said, the overall effect within the organization is one where knowledge is selectively shared resulting in modest gains in performance for the organization. If this is the norm within the organization the hoarding process will be counter productive. This is one of the critical changes that should be targeted by any KM program, and one that should have positive repercussions beyond purely the exchange of knowledge.

2. *The impact of push/pull knowledge transfer.* Whilst Kluge *et al.* (2001) acknowledge the importance of technology in delivering information at the right time and place, the deciding factor as to whether an organization will benefit is down to how the employees pull and share the information and knowledge. In essences their research shows that successful organizations use a combination of both push and pull. Push systems being top-down in design and dependant on technology for knowledge/information to flow. Pull systems being bottom-up in design and more dependent on an individual's innate desire for knowledge. It is this desire coupled with a culture of cooperation throughout the organization that determines how successful the pull delivery mechanism will be.

Figure 1 Corporate prisoner dilemma

Source: McKinsey Co.
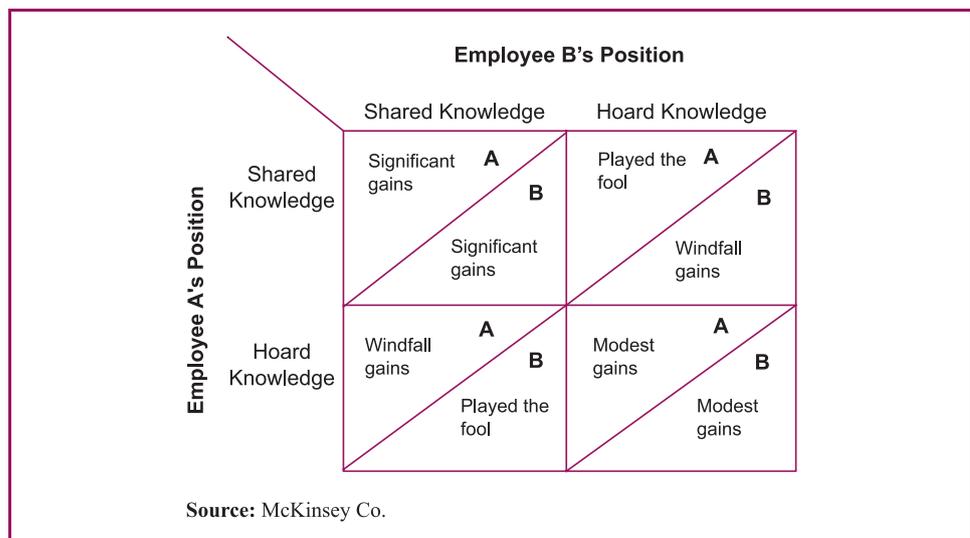
3. *The impact of interpersonal relationships on knowledge.* Szulanski (1996) also supports the view that relationships between employees contribute to knowledge transfer failures. However, he points out that prior research suggests that four sets of factors are likely to influence the difficulty of knowledge transfer. These are:

- characteristics of the knowledge transferred;
- characteristics of the source of the knowledge;
- characteristics of the recipient of the knowledge/information; and
- the context in which the knowledge/information is transferred.

Some authors place an almost exclusive emphasis on the attributes of the knowledge transferred (Zander and Kogut, 1995; Winter, 1987). Others stress the characteristics of the situation in which the transfer occurs (Arrow, 1969). However, all four sets of factors can be used together in a model that allows their relative influence to be measured. Szulanski (1996) states that contrary to conventional wisdom that places primary blame on motivational factors, the major barriers to internal knowledge transfer are shown to be knowledge related such as the recipient's lack of absorptive capacity, causal ambiguity, and an arduous relationship between the source and the recipient. Szulanski's research was derived from a series of manufacturing sites. It cannot be simply assumed that his findings will be relevant within IBM's complex supply chain. That said there is no reason to believe that the barriers described will not impact knowledge transfer to a greater or lesser degree within any organizational context.

4. *The impact of organizational structure on knowledge.* Gupta and Michailova (2004) found that knowledge sharing among departments within the same organization is in reality not as natural as it may appear. In fact knowledge sharing hostility is a phenomenon that widely dominates organizational reality (Husted and Michailova, 2002). Gupta and Michailova (2004) identified three difficulties with the process of sharing knowledge:

- *Knowledge is developed at a local level.* By definition knowledge is embedded in a certain cognitive and behavioural context. Without understanding the context one cannot inquire into the reasoning and the assumptions behind the particular piece of knowledge.

- *Knowledge is asymmetrically distributed.* Often those who possess the knowledge are not inclined to invest time and effort to share it without expecting reciprocity, as resources are finite and scarce (Davenport and Prusak, 1998, O'Dell and Grayson, 1998).

- *Knowledge sharing is voluntary.* Efficient knowledge sharing depends on the willingness of individuals to identify the knowledge they possess and to share the knowledge when required (Nonaka and Takeuchi, 1995).

Moreover, Gupta and Michailova (2004) believe that an individual's ability to appreciate new knowledge is a function of their absorptive capacity (Cohen and Levinthal, 1990; Szulanski, 1996). What is interesting about Gupta and Michailova's (2004) research is that it does not look at the organization as a single entity but as a collection of departments working together, and the different demands they place on knowledge creation. Through their research they identified three aspects of the complex organization that can hinder knowledge creation and sharing:

- *The nature of the different businesses means different knowledge management requirements.* Some departments or business units will operate within different environments; some more stable then others. Therefore, KM systems may need to be modified by department in order to support the internal knowledge creation process.

- *The different nature of the different business activities.* The nature of the different businesses predispose different requirements to the type of knowledge sought as well as different preferences to how the needed knowledge is obtained.

- *The way codified and personalised systems are used within each department or business unit.* Although the common practice is to assess organizations for codified or personalised knowledge systems, at a department level, depending on the mission

and expected deliverables of the department, the best fit from a codified or personalised strategy may not fit with the overall organization's assessment.

This is an important point as the reality of today's organization, especially a complex supply chain, is that roles and expected deliverables will vary between departments or business units. Therefore, when defining a knowledge strategy an understanding of how departments, or business units that make up the organization, use information and create knowledge needs to be taken into consideration.

5. *The impact of a codified approach on knowledge sharing.* What is also interesting from the literature reviewed is the strong belief that technology, as the primary focus in knowledge delivery systems, has time and time again failed to deliver (Barson *et al.*, 2000; Gupta and Michailova, 2004; Pawar, 2002; Marwick, 2001). The assumption that KM relies heavily upon social patterns, practices, and processes goes far beyond computer-based technologies and infrastructures (Davenport and Prusak, 1998; Coleman, 1998). Empirical evidence on barriers to knowledge sharing stresses the importance of behavioural and cultural factors rather than to outline reasons associated with technology (Skyrme and Amidon, 1997; De Long and Fahey, 2000). The emphasis on the role of technology, specifically knowledge codification, has also been questioned by Spender (1996) and Tsoukas (1996).

Pawar (2002) also question the effectiveness of a purely codified (technology driven) approach to KM. It is their belief that modern management practice has only tended to focus on centralising, controlling, and standardising knowledge. Such codification allows the marginal cost of knowledge acquisition to be reduced by economies of scale (assuming the codified knowledge is relevant and useful). This underlying philosophy in the business environment has motivated an immense interest over the last decade in KM as a business field. Pawar (2002), at the same time realise the place technology has within the effective coordination of knowledge. However, they feel that humans play more of a central role in the identification, acquisition, generation, storage, structuring, distribution, and assessment of knowledge. It is interesting that Pawar's (2002) views, although taking the softer aspects of KM in to consideration, do not really look at how organizations get their employees to ''pull'' knowledge. Malhotra (2001) also believes in line with Kluge *et al.* (2001) that there is an overarching need for the building of a knowledge culture within an organization, and the responsibility for developing this culture does not rest with the information technology specialists. In order to achieve this Malhotra (2001) believes organizations should focus on rewarding employees for what they contribute, and ensuring organizations track intellectual assets to show staff that knowledge is regarded as a valuable commodity; views which are supported by Kluge *et al.*'s (2001) research.

Categorising knowledge barriers

The literature on human issues in the vast area of knowledge management is somewhat sparse in comparison, but a study, carried out by KPMG (1998), highlighted that there is not only a lack of understanding about KM and its benefits but that there is a lack of skills within people of specific KM techniques. Barson *et al.* (2000) look at barriers to successful knowledge transfer using the TOP (Technological, Organizational, People) socio-technical systems classification as put forward by Brandt and Hartmann (1999). Barson *et al.*'s (2000) categorisation of the barriers is outlined in Table I.

This is an interesting perspective, because as many organizations fail to maximise on knowledge management performance due to failure to address the softer issues, it can be equally detrimental to performance if technical and indeed organizational issues are also neglected. A common theme that has emerged is that KM must be viewed from a holistic perspective. Failure to do so will result in an organization's failure to realise the potential it has to create and share knowledge.

Although the literature reviewed in this paper looks at the barriers to knowledge creation and sharing from slightly different angles there is a lot of commonality in the published findings.

Table I Barriers to knowledge sharing and management		
Technology	*Organization*	*People*
Existing resource	Existing resource	Existing resource
Available technology	Need for rewards	Need for rewards
Legacy systems	Culture	Culture
	Targeting	Internal resistance
	Costs	Self-interest
	Propriety knowledge	Trust
	Distance	Risk
		Fear of exploitation
		Fear of contamination
Source: Barson *et al.* (2000)		

The barriers outlined by Barson *et al.* (2000) encompass those already outlined in the literature review. A more detailed description of the categorisations of the four barrier classes is given below:

1. *Cross-category barriers*:

   ■ *Existing resource.* Simply put, if an organization is to operate knowledge creation and sharing then there must be the required resource available. The organizations must also have employees who can implement and develop the knowledge that has been accrued. This is implying a ''pull'' knowledge culture.

   ■ *Need for rewards.* This barrier concerns both organization and people. Rajan *et al.* (1998) cited by Scarborough *et al.* (1999) states that ''it is essential that employees can see that sharing means immediate gains such as less hassle, or easier tasks, reducing working hours or earlier closing''. The need for rewards is a people issue whereas the mechanism for conferring rewards is an organizational issue.

   ■ *Culture.* The Lotus Corporation (and indeed Kluge *et al.*, 2001) point out that a company's culture may not support sharing and reuse of knowledge. Although Lotus recommends overcoming this barrier through technology the general view is that this should happen through a combination of codified and personalised methods. It is important also to look at culture from a push or pull perspective as this determines largely how employees will access and use the information available. If the culture is predominantly either ''push'' or ''pull'' this maybe seen as a barrier as either the soft aspects of KM are being overlooked or the IT systems are not in place to support information routing and sharing.

2. *Technological barriers*:

   ■ *Available technology.* Swartz (1999) and Marwick (2001) suggest that technology still is unable to provide a single knowledge solution, and that an organization's codified solutions are usually a combination of applications cobbled together.

   ■ *Legacy systems.* Swartz (1999) identifies legacy systems as a significant barrier to knowledge management. Connecting the systems of multiple departments, especially when there is no common standard approach to IT deployment makes it difficult to solution an efficient knowledge transfer system.

3. *Organizational barriers*:

   ■ *Poor targeting of knowledge.* Scarborough *et al.* (1999) point out that ''information needs to be targeted if it is to serve knowledge''. Therefore, if a knowledge management system is to be effective it must be clear about what information it needs and what it expects to generate by way of knowledge.

   ■ *Cost management of knowledge transfer.* Farr and Fisher (1992) point out that a barrier to inter-organizational knowledge transfer is the cost of managing collaboration.

■ *Protection of proprietary knowledge.* Sharing of proprietary information with collaborators leaves an organization open to the risk that the information will be revealed. The consequence of this belief is that resistance grows within an organization to sharing proprietary information with suppliers.

■ *Distance.* According to Nonaka and Takeuchi (1991) the most efficient means of transferring knowledge is through face-to-face communications. However, the distributed nature of today's organization may make this difficult to do. Different cultural, legal, and linguistic environments can also impact this.

4. *People barriers*:

■ *Internal resistance.* This is where knowledge is hidden or its flow restricted in order to protect the interests of the organization.

■ *Self interest.* This is when customers may not be willing to supply information to a supplier for fear that the information will filter through to competitors.

■ *Lack of trust.* Trust impacts the way we perceive received information and the value we place on it, and also the manner in which we share information. If an individual does not trust the recipient of the information to use it wisely, and in the best interest of the organization, it will affect how much information is passed between the individuals.

■ *Risk.* Risk is related to both trust and proprietary knowledge barriers. Inter-organizational knowledge sharing inherently involves an element of risk, particularly when proprietary knowledge is being shared.

■ *Fear of exploitation.* According to Lucas (2000) a fear of exploitation starts with the premise that ''I will only share my knowledge with you if I think you can give me something in return''. Although Barson *et al.* (2000) see this as a ''people'' barrier the solution to resolving this problem is very much an organizational one.

■ *Fear of contamination.* This barrier refers to when organizations with up-market brand issues are nervous about getting together with people they perceive as more down-market (Lucas, 2000).

Defining a list of barriers for the purpose of this research

Although Barson *et al.* (2000) provide a comprehensive list of issues that support the findings of previous research they do not provide any empirical evidence as to how the barriers impact knowledge creation and sharing within a complex organization such as IBM's ISC.

There are also aspects of Pawar (2000), Kluge *et al.* (2001), and Szulanski's (1996) research that are not taken into account. Of particular interest is the impact an imbalanced ''push-pull'' knowledge strategy can have on information flow and knowledge creation. Also Szulanski's work on identifying barriers which effect knowledge ''stickiness'' within an organization need to be considered when assessing barriers in any large complex organization.

Therefore, the findings from the different research papers covered in the literature review have been collated together and assessed by the author for over-lap. The barriers identified were categorised under the TOP headings used by Barson *et al.* (2000) and are shown in Table II.

For the purposes of this research this list was used in assessing the main barriers to knowledge creation and transfer across a core IBM supply chain process. In order to help develop a concise list for the intended target audience the author has re-structured the barrier list to remove any duplication. The revised list now contains 25 barriers as outlined in Table III.

Barriers and the learning organization

From the standpoint of this research what was of key interest was how the barriers would impact on the Nonaka and Takeuchi (1995) view of the knowledge driven learning organization. Each barrier was assessed in order to determine if it would, or could, impact on any of the different knowledge transfer mechanisms; tacit to tacit, tacit to explicit, explicit to explicit, explicit to tacit. If any one of the barriers had the ability to impact the aforementioned

Table II Barriers to knowledge creation and sharing

Source		Description
	Technology barriers	
Barson *et al.*	Existing resources (money, time, technology, skills, data transfer)	Impact lack of money, time, technology, skills, and effective data transfer has on knowledge transfer. For developing codified systems
Barson *et al.*	Available technology (Does IT support knowledge requirement?)	Does existing technology support organizations knowledge strategy?
Barson *et al.*	Legacy systems (Are legacy systems impacting knowledge transfer?)	Do existing legacy systems between dept/business unit's impact knowledge creation, sharing, and distribution?
	Organizational barriers	
Barson *et al.*	Existing resources (money, time, technology, skills, data transfer)	Impact lack of money, time, technology, skills, and effective data transfer has on knowledge transfer. For creating a knowledge delivery system (codified/personalised)
Barson et al./Kluge *et al.*	Rewards (individuals rewarded for sharing/creating knowledge)	How are individuals motivated to share and create knowledge within the organization?
Barson *et al.*/Kluge *et al.*	Culture (knowledge strategy)	Does the organization have a balanced knowledge creation and deployment strategy? (Push v. Pull)
Gupta and Michailova	K Strategy implementation	Does the strategy fit with how knowledge is created and shared within the department or business unit?
Szulanski	Causal ambiguity	Depth of knowledge/Does the individual or group know what the information/knowledge is supposed to be used for?
Barson *et al.*	Poor targeting of knowledge	Does the organization utilise its knowledge sources effectively?
Barson *et al.*	Knowledge cost	Does the cost of managing collaboration impact knowledge transfer in the organization?
Barson *et al.*/Pawar *et al.*	Proprietary knowledge	Does the organization share its proprietary knowledge with suppliers/outsourced partners?
Barson *et al.*/Pawar *et al.*	Distance (geographical, culture, language, legal)	Does geographical distance/language differences/cultural differences impact knowledge sharing?
Szulanski	Arduous relationship	Does a lack of communication and intimacy of the relationship with co-workers impact knowledge sharing?
Szulanski	Unproven (Is knowledge rated as being of value?)	Degree to which knowledge is seen as useful based of previous experience of knowledge source
Szulanski	Organizational context	Degree to which the organization context supports the development of knowledge transfers
Szulanski	Info not perceived as reliable	Degree to which the donor of the best practice is perceived as reliable
Szulanski/Kluge *et al.*	Lack of motivation (knowledge as power syndrome)	Motivation of source to support knowledge transfer
	People barriers	
Barson *et al.*	Existing resources (money, time, technology, skills, data transfer)	Impact lack of money, time, technology, skills, and effective data transfer has on knowledge transfer. For allowing the individual to access/create/share knowledge
Barson *et al.*	Rewards	How are individuals motivated to share and create knowledge within the organization
Barson *et al.*/Kluge *et al.*	Internal resistance (protect interests of organization/business unit)	How the desire to protect the interests of the department/business unit/organization effects an individuals desire to share information/knowledge

Table II

Source		Description
Barson *et al.*	Self interest (expose knowledge to competition)	Holding back on knowledge sharing with co-partners because of a belief that the knowledge will filter to competitors
Barson *et al.*	Trust (trust for Individuals sharing knowledge with)	Does the individual trust the source or recipient of the knowledge to use it correctly?
Barson *et al.*	Risk (including fear of penalty, losing profit)	Are there any risks that will affect knowledge sharing such as penalty clauses, profit risks?
Barson et al./Pawar *et al.*	Fear of exploitation	Fear of sharing knowledge because it knowledge is perceived to only flow one-way
Barson *et al.*	Arduous relationship	Ease of communication and intimacy of the relationship
Szulanski	Lack of motivation (not invented here syndrome)	Motivation of recipient to support knowledge transfer
Szulanski/Kluge *et al.*	Fear of undermining position	If the knowledge is shared will it undermine the individual's worth to the organization?
Kluge *et al.*	Fear of contamination	Failure to work together because of perceived differences in professional capability
Barson *et al.*	Lack of retentive capacity	Ability of recipient to routinise the use of new knowledge
Szulanski	Lack of absorptive capacity	Ability of recipient to identify value and apply new knowledge
Gupta and Michailova	Knowledge system modification	How much flexibility individuals have in modifying systems to provide the necessary information or knowledge?

Table III Concise list of barriers

Source	
	Cross category barriers
Barson *et al.*	Existing resources (money, time, technology, skills, data transfer)
Barson *et al.*/Kluge *et al.*	Rewards (individuals rewarded for sharing/creating knowledge)
Szulanski	Arduous relationship
Barson et al./Kluge *et al.*	Culture (knowledge strategy)
	Technology barriers
Barson *et al.*	Available technology (Does IT support knowledge requirement?)
Barson *et al.*	Legacy systems (Are legacy systems impacting knowledge transfer?)
	Organizational barriers
Gupta and Michailova	Knowledge strategy implementation
Szulanski	Causal ambiguity
Barson *et al.*	Poor targeting of knowledge
Barson *et al.*	Knowledge cost
Barson *et al.*/Pawar *et al.*	Proprietary knowledge
Barson *et al.*/Pawar *et al.*	Distance (geographical, culture, language, legal)
Szulanski	Unprovenness (Is knowledge rated as being of value?)
Szulanski	Organizational context
Szulanski	Info not perceived as reliable
Szulanski/Kluge *et al.*	Lack or motivation (knowledge as power syndrome)
	People barriers
Barson et al./Kluge *et al.*	Internal resistance (protect interests of organization/business unit)
Barson *et al.*	Self Interest (expose knowledge to competition)
Barson *et al.*	Trust (trust for individuals sharing Knowledge with)
Barson *et al.*	Risk (fear of penalty, losing profit)
Barson *et al.*/Pawar *et al.*	Fear of exploitation
Szulanski	Lack of motivation (not invented here syndrome)
Kluge *et al.*	Fear of contamination
Szulanski/Gupta and Michailova	Lack of retentive capacity
Szulanski	Lack of absorptive capacity

mechanism it was listed in the respective quadrant. Figure 2 shows Nonaka's Organizational Learning Model with the 25 barriers mapped to the quadrant that they influence.

It is important to note that whilst the barriers are unevenly distributed across the learning organization model it does not mean that the barriers will always be present in these areas. What Figure 2 shows is simply that these barriers may impact to a greater or lesser degree in these quadrants. Also, although the barriers are numbered this should not be taken to infer a weighting. The identified barriers may or may not appear depending on the organisation, or even part of the organization being assessed. What can be inferred from Figure 2 is that barriers will impact the learning organizations ability to identify, create, and share information and knowledge. Therefore, a more accurate view of the learning spiral is shown in Figure 3.

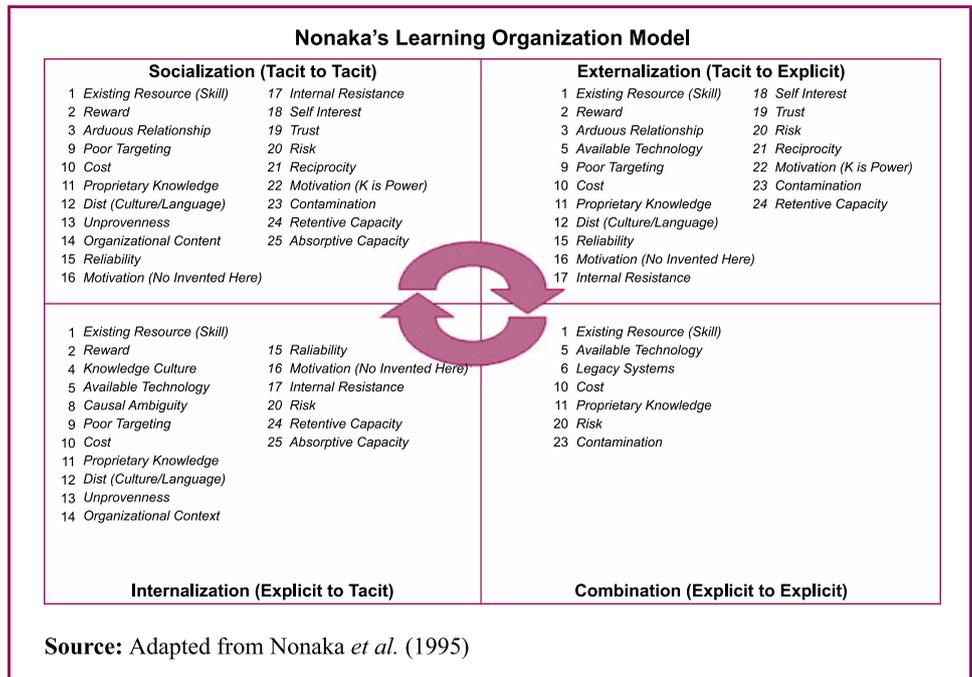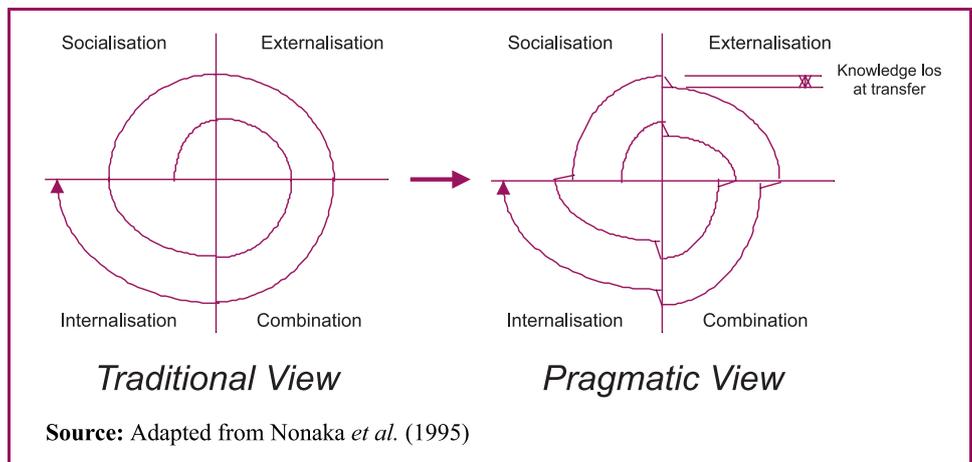**Figure 2** Learning model with barriers

Nonaka's Learning Organization Model

Socialization (Tacit to Tacit)		Externalization (Tacit to Explicit)	
1 Existing Resource (Skill)	17 Internal Resistance	1 Existing Resource (Skill)	18 Self Interest
2 Reward	18 Self Interest	2 Reward	19 Trust
3 Arduous Relationship	19 Trust	3 Arduous Relationship	20 Risk
9 Poor Targeting	20 Risk	5 Available Technology	21 Reciprocity
10 Cost	21 Reciprocity	9 Poor Targeting	22 Motivation (K is Power)
11 Proprietary Knowledge	22 Motivation (K is Power)	10 Cost	23 Contamination
12 Dist (Culture/Language)	23 Contamination	11 Proprietary Knowledge	24 Retentive Capacity
13 Unprovenness	24 Retentive Capacity	12 Dist (Culture/Language)	
14 Organizational Content	25 Absorptive Capacity	15 Reliability	
15 Reliability		16 Motivation (No Invented Here)	
16 Motivation (No Invented Here)		17 Internal Resistance	

1 Existing Resource (Skill)		1 Existing Resource (Skill)	
2 Reward	15 Raliability	5 Available Technology	
4 Knowledge Culture	16 Motivation (No Invented Here)	6 Legacy Systems	
5 Available Technology	17 Internal Resistance	10 Cost	
8 Causal Ambiguity	20 Risk	11 Proprietary Knowledge	
9 Poor Targeting	24 Retentive Capacity	20 Risk	
10 Cost	25 Absorptive Capacity	23 Contamination	
11 Proprietary Knowledge			
12 Dist (Culture/Language)			
13 Unprovenness			
14 Organizational Context			

Internalization (Explicit to Tacit)	Combination (Explicit to Explicit)

Source: Adapted from Nonaka *et al*. (1995)

Figure 3 Knowledge losses in the learning model

Traditional View   *Pragmatic View*

Source: Adapted from Nonaka *et al*. (1995)

Knowledge loss across the learning organization

Figure 3 shows the traditional view as proposed by Nonaka and Takeuchi (1995) juxtaposed with a more pragmatic view showing the effect the quadrant related barriers might have on the learning process. The author hypothesises the impact of the barriers (knowledge loss at transfer) will depend on the whether the barriers exist, and to what level they are managed within the organization.

Taking the pragmatic view a step further, if the barriers within the organization are allowed to impact knowledge creation and transfer without being identified and managed, the learning spiral may conceivable collapse as shown in Figure 4.

Figure 4 shows how the organization fails to utilise, on its tacit to explicit to tacit transfer mechanisms, due to the actions of unchecked barriers within the organization. Barriers can and will impact to different degrees across the organization so the knowledge loss at transfer, as shown in Figure 4, will vary through the different quadrants. Therefore, organizations that simply see KM as the implementation of bigger and better IT systems are possibly only addressing barriers within the ''Combination'' section of the learning model. If organizations are to stand a better chance of achieving their KM requirements they will need to identify and understand how the different barriers exist within their organization, and impact the learning process across the four quadrants.

Existence of barriers within a complex organization

Having identified and hypothesised around the 25 barriers to knowledge and information sharing it was important to see how they may impact upon a real organization. From the point of view of on-going research the existence of the barriers impacting employees along a core business process would be of relevance. For the purpose of this research the core IBM process chosen against which the barriers would be tested for was the order flow process. This process follows customer orders for computer hardware from initial receipt into IBM through the fulfilment, scheduling, manufacturing, and distribution components of the supply chain.

If the barriers did not appear uniformly across the organization this would in turn indicate differences in knowledge and information access/creation/sharing practices amongst employees involved in operating a core process. If this was the case, then the deployment of a ''blanket'' KM strategy could fail to address key aspects of how employees work together.

The relevance of the 25 barriers was tested by an on-line survey of IBM staff from across the order fulfilment process. Such on-line surveys are common within IBM and the questions along with an explanation of the context, relating to the barriers were embedded within a routine employee survey. The questions in the survey were looking for answers that are not continuous but categorical in structure. As part of the operational research plan the authors

Figure 4 Knowledge losses in the learning model

Pragmatic View

Source: Adapted from Nonaka *et al.* (1995)
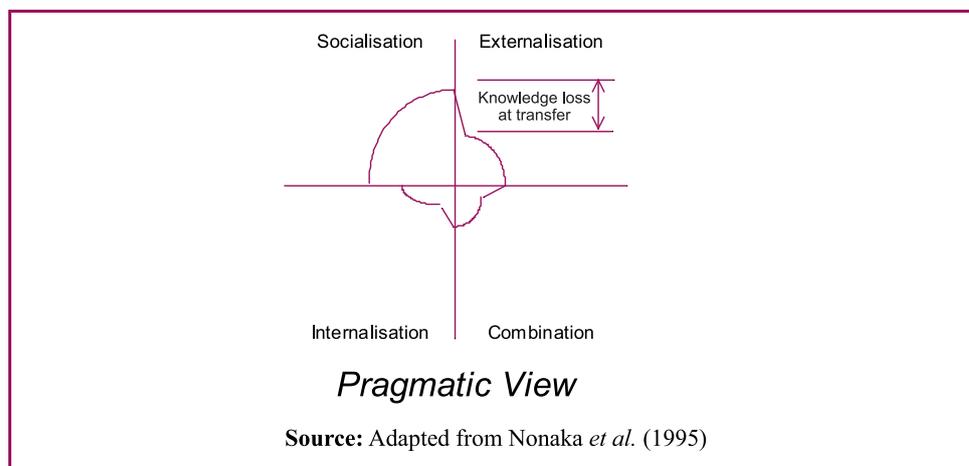
were looking to determine how the barriers are perceived to exist within the each employee work group operating along the core business processes relative to each other. The intent is not to determine a level of variance or frequency with which barriers appear across the E2E process. Because of this the questions have deliberately been structured to provide categorical, in particular, ordinal, answers. The type of variable response, or answer, is very important in determining the type of testing to be used. The actual type of non-parametric testing is further determined by the number of groups to be compared, and whether the groups will be tested independently, or dependently (Diamantopoulos and Schlegelmilch, 1997; Miller, 2000). In the case of this data analysis there will be eight group comparisons made. The eight groups identify the core supply chain process work groups within and across the organization. Also important to note is that as each individual will only be questioned once as part of a predefined group; therefore, the groups will be ''independently'' tested. Using these criteria the test selected was the Kruskal-Wallis one-way ANOVA test (Diamantopoulos and Schlegelmilch, 1997, Miller, 2000, Hinton, 2004). Another important attribute of the Kruskal-Wallis test was its ability to analyse and compare data from groups of different sample size. This would be important as the groups identified were not all of the same size, nor, more importantly could the return rate be guaranteed to be the same for all groups. The level of responses received across the different groups is shown in Table IV.

Barrier impact across the supply chain

From Table IV it can be seen the overall level of response from the different groups identified for survey was 23.51 per cent. What resulted was confirmation that the 25 barriers, as identified by the literature review and amended by the research, existed to greater or lesser extents throughout the different parts of the organization involved with the process. Although all the barriers appear to a greater of lesser extent across the organization, Kruskal-Wallis analysis (Table V) shows that not all barriers act uniformly across the organization.

From the significance levels reported the following barriers are perceived to impact knowledge creation and sharing differently across the core process:

- arduous relationships;
- available technology;
- legacy systems;
- knowledge implementation strategy;
- causal ambiguity;
- knowledge cost;.
- distance;
- unprovenness;
- trust;

Table IV	Level of response to questionnaire		
Group	% of population responding	n	N
Order fulfilment	15.51	38	245
Supply/demand planning	25.00	8	32
Manufacturing	53.33	16	30
Distribution.	22.45	11	49
E2E Order management	20.59	21	102
E2E Re-engineering	26.00	13	50
Administration	54.17	13	24
Senior management	87.50	7	8
Total	23.51	127	540

Notes: n = Sample size; N = Population size

Table V Kruskal-Wallis analysis	
Barrier	*p*
Existing resource	1.000
Rewards for sharing/creating knowledge	0.584
Arduous relationship	0.024
Culture (knowledge strategy)	0.120
Available technology	0.008
Legacy systems	0.000
Knowledge strategy implementation	0.000
Causal ambiguity	0.016
Poor targeting of knowledge	0.280
Knowledge cost	0.000
Proprietary knowledge	0.392
Distance	0.008
Unprovenness	0.000
Organizational context	0.304
Info perceived as reliable	0.168
Lack of motivation (not invented here)	0.120
Internal resistance	0.224
Self interest	0.760
Trust	0.024
Risk	0.000
Fear of exploitation	0.072
Lack of motivation (knowledge as power)	0.736
Fear of contamination	0.048
Lack of retentive capacity	0.696
Lack of absorptive capacity	0.720

Notes: $n = 125$; $N = 540$; $\alpha = 0.05$
Source: Developed for research

- risk; and

- fear of contamination.

The remaining barriers when tested had a significance level >0.05. This meant for these barriers no conclusion could be drawn as to whether they impacted differently across the different groups employed along the core process. However, what could be determined was if the barriers were actually seen to exist across the organization. For the overall results all the barriers outlined in Table IV were seen to exist, albeit to varying degrees of impact.

Wider implication of barrier analysis

The barrier profile identified through this research relates to a particular supply chain organisation and process that has distributed business elements across EMEA. The social and cultural profile of this organization will not be the same as that experienced within other large complex organizations, and as such the authors believe other organizations will exhibit different barrier impact profiles. The emphasis on different barriers will differ depending on organizational and national cultures, social habits, interpersonal relationships, levels of technology availability etc., The purpose of this research was not to identify a generic complex organizational barrier profile. In fact the purpose was simply to identify a set of commonly observed knowledge barriers and demonstrate that these barriers can manifest in different ways across an organization. From a practical perspective the barriers identified through this research were directly targeted as part of a performance improvement initiative by IBM's supply chain organization (McLaughlin *et al.*, 2006). This initiative resulted in significant process performance improvement. Therefore, although the authors would not advocate other organizations embark on a knowledge sharing improvement initiative based on the specific barrier profile identified in this paper, they would recommend organizations embark on a barrier profiling exercise, based on the list of 25 barriers identified in this paper, along their core business processes.

Conclusion

The outcome from this research shows that the 25 barriers identified in this paper exist, and are seen to impact across a complex supply chain. However, this in itself is not the key point of interest concerning this paper. What the research demonstrates is that the barriers themselves impact differently across the organization. This, in effect, means that employee's information and knowledge creation and sharing practices will vary not only within the organization, but also along core complex process pathways. It is also important to note that an assessment of how barriers exist and impact along core complex processes would be expected to vary from organization to organization. How organizations create and share information and knowledge is vitally important if an innovative, responsive business is to be developed. As core complex processes are the mechanisms by which business performance is driven, information and knowledge creation and sharing along these arteries must become a key focus point for business success. Therefore, barriers that impact along these processes must be understood and where possible managed.

Another consideration this raises for organizations with complex business processes is that different barriers will need different solutions. How barriers impact the tacit-explicit-tacit transfer mechanism along a process will determine the type of solution needed at that part of the process. Therefore, the deployment of a generic IT or business solution across the organization cannot now be expected to fully support the operational needs of employees along a complex process. For organizations to effectively manage their supply chains they must consider the operation of their core supply chain processes. From this point they should then look to understand how employees create and share information and knowledge along this process and which barriers are seen to impact. Only when this has been achieved can the organization effectively fine-tune the performance of the process through the removal or management of the core process barriers.

Further research

As stated at the beginning of this paper, this research forms part of a wider research project. From this paper some important follow-on questions and research opportunities can be considered. First, if an organization is to look first to its processes and understand how barriers impact at different stages along them, how will this affect the choice of supporting information and knowledge management systems? The barriers identified can be driven by internal, external or a combination of both internal and external organizational influences. As such the best approach to managing the barriers once identified can be either codified or personalised. However, only through identifying and understanding the influencing parameters of each barrier will the organization know the best way of reducing or managing the barriers impact. Therefore, if the dominant barriers change between codified and personalised in nature along the process how does this affect the development of an organization's IT strategy?

Second, from a barrier perspective, the identification of barriers might be a lot easier then the practical management of them. However, if there was precedence between barriers that could identify those with the most influence on other barriers, then an organization could focus on those barriers with most impact. Therefore, how do these barriers interact and affect one another?

The above questions are imbedded within the on-going research being conducted by the research team. The results gleamed from IBM are being tested across a range of organizations, from across a range of service and manufacturing industry and within the public and private sectors. Not only should this assist in determining the transferability of the research outcomes but it should also assist in the consideration of the impact of dynamic external factors. The authors are currently researching the extent to which the observations are generic and the findings will form the basis of further publications.

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Further reading

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