

6

Knowledge Transfer Process Cycle: Between Factory Floor and Middle Management

by

Andreas Riege †

Michael Zulpo †

Abstract:

Factory floor workers can add value to their firm from new knowledge they may discover whilst performing their daily tasks. The transfer of that knowledge to middle managers can improve process efficiencies, if they can utilise it. Researchers and practitioners perceive value in understanding a range of knowledge transfer strategies and initiatives, yet there is little empirical evidence on ground level knowledge discovery and bottom-up knowledge transfers in a manufacturing environment. Our results show that factory workers do not codify their knowledge and only articulate it personally. Thus firms must provide an environment that supports knowledge exchanges within the factory worker community and upwards to middle managers whom act as knowledge facilitators rather than knowledge creators between factory workers and upper management.

Keywords:

**KNOWLEDGE TRANSFER; KNOWLEDGE DISCOVERY; MANUFACTURING;
FACTORY WORKER.**

† Griffith Business School, Department of International Business and Asian Studies,
Griffith University, 170 Kessels Road, Brisbane, Queensland 4111.
Email: a.riege@griffith.edu.au

Australian Journal of Management, Vol. 32, No. 2 December 2007, © The University of New South Wales

1. Introduction

Manufacturing industries are generally highly process-based with workers requiring specific knowledge to perform their jobs effectively. This knowledge is often created over a span of a few years if not decades and as much intrinsic to processes as to manufacturing workers (Kim, Hwang & Suh 2003). Knowledge management in manufacturing environments thus far have received relatively little attention in comparison to service-related industries. Process-oriented manufacturing environments are driven by a need to continuously improve on the coordination of workflows, control of complex production activities, proficiency of machines, process and operational efficiencies, and manufacturing worker productivities. All of these knowledge types can be classified as tacit in that they are complex and difficult to contextualise and articulate. Whilst manufacturing workers, in particular factory floor workers, highly influence the level of productivity of manufacturing firms, they also seem to be alienated from most other organisational areas such as middle and especially upper management.

Successful transfer of knowledge, particularly tacit knowledge, implies a universal meaning and homogeneous context within firms. In practice, however, this assumption rarely holds. Indeed, knowledge-transfer difficulties between knowledge communities are often a result of differences in their language, practical experience, situational and sub-cultural understandings, social behaviour, occupational contexts, network position, and absorptive capacity (Bechky 2003; Tsai 2001). Due to these and other potential transfer difficulties, such communities of practitioners bring very different perspectives to their collaborative efforts, and 'participation in such communities, through the means such as storytelling and apprenticeship, leads members to share common understandings of their world' (Bechky 2003, p. 314). Whilst we know that knowledge communities offer practitioners a valuable means for learning and competency development, it is important to examine how the different understandings of different knowledge communities are communicated successfully across groups. This paper examines knowledge processes and flows between the knowledge communities of the factory floor worker and their operational supervisors in middle management.

This study attempts to make several core contributions to the extant literature. Firstly, it shows how manufacturing workers discover new knowledge on the factory floor, and how they share that knowledge within their community and upstream with members of the middle management community. Secondly, it clarifies the role of middle managers in the knowledge transfer process between the factory floor and middle management communities. Thirdly, our study reports on respondents' motivations and effective transfer methods to articulated knowledge, tools used to communicate newly generated knowledge amongst the same or different organisational levels, and the importance of relationship strengths within and between both communities. Finally, the conceptual framework highlighting knowledge processes and flows presented herein serves as a valuable basis for comprehending the nature as well as inherent factors and parameters affecting any knowledge exchanges between factory worker and middle management communities.

The remainder of the paper is organised in five main sections. The next section begins with a brief review of the extant literature and proposes four specific research questions, followed by an introduction of our theoretical framework

encompassing interrelationships between factory floor workers and middle management. The model focuses on bottom-up flows of newly discovered knowledge in terms of learnt efficiencies and process improvements and top-down flows of new best practice policies in terms of improved manufacturing processes.

Following a brief review of the literature, we highlight the research methodology and key research findings. Finally, we present our conclusions including theoretical and managerial implications.

2. Theoretical Background and Framework

Competitive advantage is increasingly sourced from firms' ability to increase efficiencies, skills, and the accumulation of knowledge (Nieminen & Nummela 2003). Processes involved in the accumulation of knowledge are the recognition or identification of relevant knowledge, the articulation and transfer of knowledge between people internal and external to the firm, and the ability to disseminate and store knowledge in a purposeful and readily accessible form. Factory workers follow set processes to produce a product or complete a stage of a production process. Their work is often highly physical, and hence it can be assumed that factory workers' scope of possible knowledge discovery lies within the realm of physical processes and know-how.

Before investigating the literature pertaining to the factory floor worker, the term 'factory floor worker' and the context in which this paper uses the term should be made clear. A factory floor worker, hereafter referred to as a factory worker, is a person whose job is to perform process-based tasks to create products central to a manufacturing firm's business. The term does not reflect the personal or business aptitude of the worker, but merely the hierarchical status of the worker within a firm. The factory worker, for instance, would be an employee in firms manufacturing electrical goods whose job is to assemble parts to make a component for the end product, or an employee in a construction materials firm who creates fibro sheeting or roof truss frames. The occupation of factory workers is usually physical and follows a structured process, and workers' understanding of the process and product is based on the context of their daily encounters with machines and products. In examining the working environment, the performance of factory workers in undertaking their specific production tasks usually does not involve the frequent use of computers to share knowledge. Hence, it seems unlikely for a computer network to support knowledge transfers within their community or to another.

In spite of that the knowledge management domain tends to focus on the notion that people access knowledge through employee interactions and computerised networks (Brown & Duguid 1991; Erickson & Kellogg 2003). In fact, central to the concept of a knowledge community is the notion of a computer network forming a cornerstone to enhance communications and operations as it allows communities to transfer knowledge through devices such as databases, electronic mail, and other groupware applications (Newell, Robertson, Scarbrough & Swan 2002). However, it is questionable if interactions between different knowledge communities can only function effectively through a networked computerised system. Stevens (2000) investigated the existence of knowledge communities at the World Bank, concluding that knowledge communities are

comprised of employees who share common proficiencies or expertise, technical know-how, or are just interested in a similar subject matter. A network technology is not a prerequisite of a functional knowledge community. Indeed, some authors offered a broad notion of the knowledge community suggesting that their primary purpose lies in the creation, dissemination and transfer of collective knowledge between individual employees or groups sharing some common ground without the need for computerised communication systems (Kramer 1999; Hertog & Huizenga 2000). This view opens further opportunities when investigating and evaluating factory workers or groups of factory workers as a knowledge community.

Indeed, the nature of the knowledge discovered by factory workers seem inherently different from the knowledge discovered by other people or groups, such as engineers, technicians, middle managers or senior executives. This inherent difference is due to the job tasks performed by factory workers and other employees who may not be perceived to be 'knowledge workers'. That is, a factory worker's scope of possible knowledge discovery is predominately influenced by day-to-day tasks. Those employees who are connected to a firm-wide computer network have the ability to connect via the Intranet or Internet, permitting contact with resources, communities of interest and influences that extend beyond the internal and external boundaries of a firm (Garvey & Williamson 2002). However, for factory workers who rarely are connected to networks outside their immediate work environment, the scope of their knowledge appears to be influenced mainly or only by internal work- and communication-flows and tasks they perform themselves.

Whilst organisational work processes can benefit from a division of labour, the location-specific understandings caused by such differentiation can hinder the communication and knowledge flow between different organisational communities (Bechky 2003). For factory workers, the scope of their knowledge tends to lie in the practical processes of how to perform a particular task. That is, the factory worker gains knowledge through self-discovery and ongoing learning of processes. Hertog and Huizenga (2000, p. 105) refer to this knowledge as 'operational knowledge' as it is gained from the execution of tasks and based on actions. Furthermore, De Long and Fahey (2000) support such a view of knowledge in what they coined 'structured knowledge', or knowledge embedded in a firm's routines, systems and processes. To our knowledge, there is no empirical evidence explaining how factory workers discover more efficient ways of performing particular tasks and then articulating this newly generated knowledge within their own community or middle management. Such new discoveries tend to lie outside the realm of firms' known routines, systems and processes.

For many manufacturing firms, core competencies tend to lie in distinct organisational processes, generalised organisational abilities, routines and knowledge fundamental to efficient running of machinery (Teece 1998). Core competencies relevant to a factory worker's job lay in the routines of assembly and manufacturing processes. That is, the main means by which a factory worker generates knowledge is as a product of experience, observation and learning by doing (Brooking 2000; Nonaka & Takeuchi 1995). In addition, Hertog and Huizenga (2000) refer to 'enabling competencies' that are the doing or knowledge of physical processes that is specific to firms. Enabling competencies are often embedded in the stages of firms' value chain such as R&D and production. It is

within the production stage where the factory worker performs those enabling competencies and potentially discovers more efficient ways of performing a certain task or process. Consider, for instance, a quicker sequence of assembly of a certain component or a more efficient process of manufacture to produce a product. Irrespective of the discovered process, factory workers can contribute to enhancing the level of organisational competency. On the basis of the above brief literature review, we propose the first research question:

Research Question 1: *How do factory workers discover new knowledge or process efficiencies?*

Thus far we argued that factory workers interact and exchange ideas within their individual knowledge community. That is, the factory worker knowledge community has a different function from that of other knowledge communities, such as that of middle managers, who tend to focus on more complex operational and managerial tasks. In particular, knowledge communities comprising of middle managers appear to function as a facilitator of knowledge, suggesting that their primary role is to gather knowledge discovered by other knowledge communities and then codify, implement and disperse this knowledge (Blumentritt & Hardie 2000). This notion of facilitator suggests that middle management is just a pathway for knowledge to flow from one part of a firm to another, possibly suggesting that it could be replaced by a networked system of electronic communication facilitating knowledge flows. Naisbitt and Aburdene (1985, p. 12) supported this view arguing that middle managers are ‘people who collect, process and pass information up and down the hierarchy [and] are losing out to smart technology in the race for productivity’, further suggesting that ‘what really enables us to shrink middle management is the computer, which gives top executives immediate access to the information previously obtained from middle managers ... Now with the computer to keep track of information and people, middle managers are seen as disposable’.

Yet, 20 years after this proclamation we have not seen a significant decline in the size of middle management in commercial firms. This is possibly due to middle managers having access to and communication with all organisational parts thus allowing them to act as promoters or anchors of knowledge management initiatives. In support of this function, Ahmed, Kok and Loh (2002) argued that one of middle managers’ core functions is the identification, recruitment, encouragement, and acknowledgement of knowledge champions throughout a firm. Similarly, other authors suggested that it is the role of middle managers to explore a firm’s culture that is likely to support diverse knowledge sharing initiatives, identify a set of knowledge building activities supporting knowledge agendas, and clarify existing organisational norms and practices standing as barriers to knowledge sharing initiatives (De Long & Fahey 2000; Hauschild, Licht & Thomas 2001). That is, there is a discussion about whether the role of the middle managers is process-based, focusing on receiving and distributing knowledge, or support-based, promoting and encouraging diverse organisational parts to participate in knowledge-sharing activities. Alternatively, middle managers’ function perhaps lies in performing both roles at the same time.

Furthermore, many knowledge-centric works have concentrated on the process of codifying tacit knowledge and articulating tacit into explicit knowledge (Argote 1999; Newell et al. 2002; Nonaka & Takeuchi 1995; Spender 1996;

Szulanski 1996). Once transferred from one person or group to another, such as from the factory worker to middle management, knowledge usually is still in an uncodified state. This knowledge must then be codified to create meaning and value. Codifying suggests that by articulating tacit knowledge into more explicit formats, not suggesting that this is always possible, it can be more easily distributed and is more commonly understood. For instance, once middle managers received information from factory workers or factory workers' knowledge communities, there must be a process that is applied to codify and create value from that received information. That is, 'when a routine is made explicit, it is frequently codified in the language that is resident in the community of its origin. This language may be inexplicable to members of other communities' (Bechky 2003, p. 327). There are ways to overcome such transfer barriers, for example, storytelling seems an effective way to share knowledge within the same knowledge community (Orr 1990), whereas explicit, hands-on demonstrations often seem to offer a better foundation to explain relationships between different contexts and local understandings between communities (Bechky 2003). It is necessary to examine how certain knowledge can best be distributed to middle managers and back to the knowledge discoverers once it has been codified. Earlier we argued that delivery systems other than computerised ones need to be pushed by firms to distribute knowledge from and to knowledge communities that usually work outside the realm of an electronic network. On the basis of the above argument we propose two more research questions.

Research Question 2: *What functions do middle managers perceive themselves performing in relation to facilitating bottom-up and top-down knowledge flows?*

Research Question 3: *How can middle managers create value from the knowledge received by factory floor workers?*

The successful transfer of discovered knowledge into an integrated organisational process can add value in terms of organisational competencies and competitive advantage to a firm. We argue that factory workers having discovered more efficient ways of performing a process or task should transfer this discovered efficiency to those individuals, communities or parts of the firm that can implement that new knowledge into revised or new process, thus adding value. Next it is necessary to examine possible knowledge transfer impediments and methods between the knowledge community of the factory workers and middle management.

Ostroff and Smith (1992) advocated the view that firms focusing on processes will automatically generate cooperation between people and knowledge communities. However this does not take into account the human aspect of communication that is embedded in people's motivations, capabilities, personality, firm- or group-specific cultures, and other potential barriers such as hierarchies and geographical distance that can limit the level of cooperation (Blumentritt & Hardie 2000; Riege 2005; Sveiby & Simons 2002). In particular, Goldhaber (1993, p. 221) investigated diverse knowledge transfer barriers in bottom-up communication flow between factory workers and their superiors, noting four key outcomes. Factory workers tend to: (1) distort information upward in a manner that pleases their

superiors; (2) tell their superiors what they want them to know; (3) tell their superiors what they think they want to hear; and, (4) tell their superiors information that reflects favourably on themselves and/or does not reflect negatively on themselves. Further, Schermerhorn, Hunt and Osborn (2004) examined the influence of status on communication flows between managers and their staff, reporting a significant limitation on the upward flow of information. Status effects in firms can occur due to differences in hierarchy levels, for instance between middle managers whom are considerably higher in the organisational hierarchy than factory workers. This suggests that status effects may influence the effectiveness of bottom-up transfer of newly discovered knowledge and efficiencies. There seems to be a correlation between the four effects on bottom-up communication and the status effect theory. However, neither study offers any specific explanation of what can be expected to occur in the manufacturing industry. In addition to Schermerhorn, Hunt and Osborn's (2004) work, we need to consider the cause of communication difficulties or casual ambiguity. As identified by Szulanski (2003), casual ambiguity in factory floor communication is the result of a feeling of intimidation on the part of the factory worker. That is, if factory workers feel intimidated by their superior, they tend to selectively withhold information that may be important but reflect badly on themselves, make the superior angry, or create problems for the superior. Casual ambiguity may be the result of the existence of status effect within the organisation.

Several researchers advocated an IT infrastructure as the basis of support for any effective knowledge transfer process (Goh 2002; Rumizen & Stemke 2001). The academic and practitioner-related literature provides numerous examples of firms adopting technology-based mechanisms such as groupware systems as a support tool for more effective knowledge transfer within and across firms. Whilst that may be relevant and beneficial to many internal and external elements of a firm, there are some elements such as factory workers that do not, cannot or will not accept the use of new technologies or software applications. Yet they may discover important new knowledge. The adoption of a knowledge repository, or file sharing system, would be a completely new dimension to factory workers, as most do not seem to use computers during their day-to-day activities and routines. Hence it seems to be difficult for workers who do not use computers in this capacity to adapt to any specific system. Nonetheless their discovered knowledge is no less valuable to a firm. That is, if knowledge discovered by factory workers is to be recognised as a viable and new source of knowledge, then the focus on transferring this knowledge must shift to the ability of the factory worker to indeed transfer that knowledge to someone in the firm who can codify it into a format that can be distributed to people it would most benefit. It is likely that transfer mechanisms are based on direct communication tools in either a formal or informal format.

Outside the technology solution, there are numerous informal knowledge transfer avenues including casual business conversations occurring, for instance, in lunchrooms and cafeterias, around the coffee machine, or at the pub after work. Similarly to informal methods, firms can adopt formal methods to facilitate knowledge flows and exchanges, such as education and training programs, briefings and debriefings, regular team meetings and brainstorming sessions. All of these options do not require any IT support but rely heavily on face-to-face contact, thereby giving factory workers, outside firms' IT network structure, opportunities

to exchange knowledge. Based on the above discussion, a fourth research question is proposed.

Research Question 4: *How can discovered knowledge be transferred most effectively from factory floor workers to middle management and vice versa?*

The following two diagrams illustrate our theoretical framework. Figure 1 shows the interrelationship of the factory floor worker and middle management. The model focuses on: (1) the discovery of new knowledge or process efficiencies on the factory floor (research question 1); the bottom-up flow of that newly discovered knowledge in terms of learnt efficiencies and process improvements, and the subsequent top-down flow shows the transfer of new best practice policies in terms of improved manufacturing processes (research question 4); and the role of middle management in facilitating the transfer of relevant knowledge and purposeful sharing on the factory floor as well between workers on the factory floor and management (research question 2 and 3).

Figure 1
Knowledge Flows Between Knowledge Communities in Heavy Manufacturing Environments

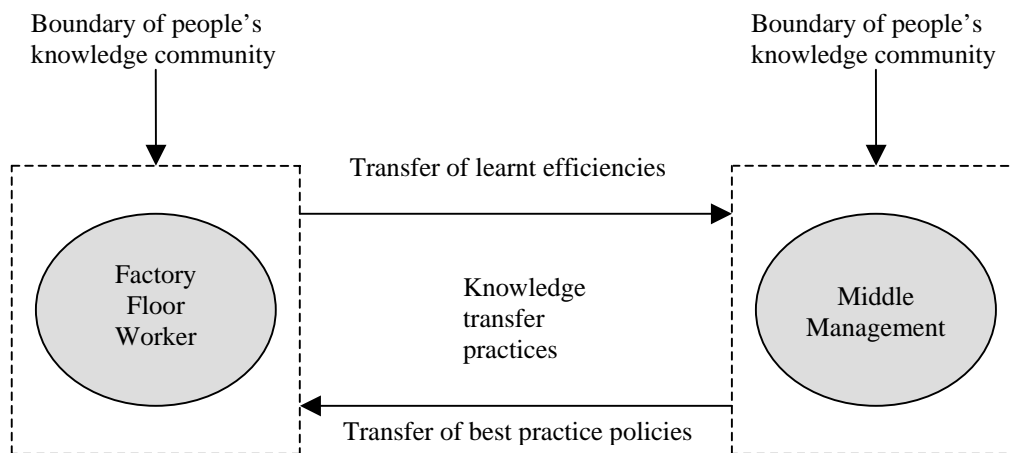
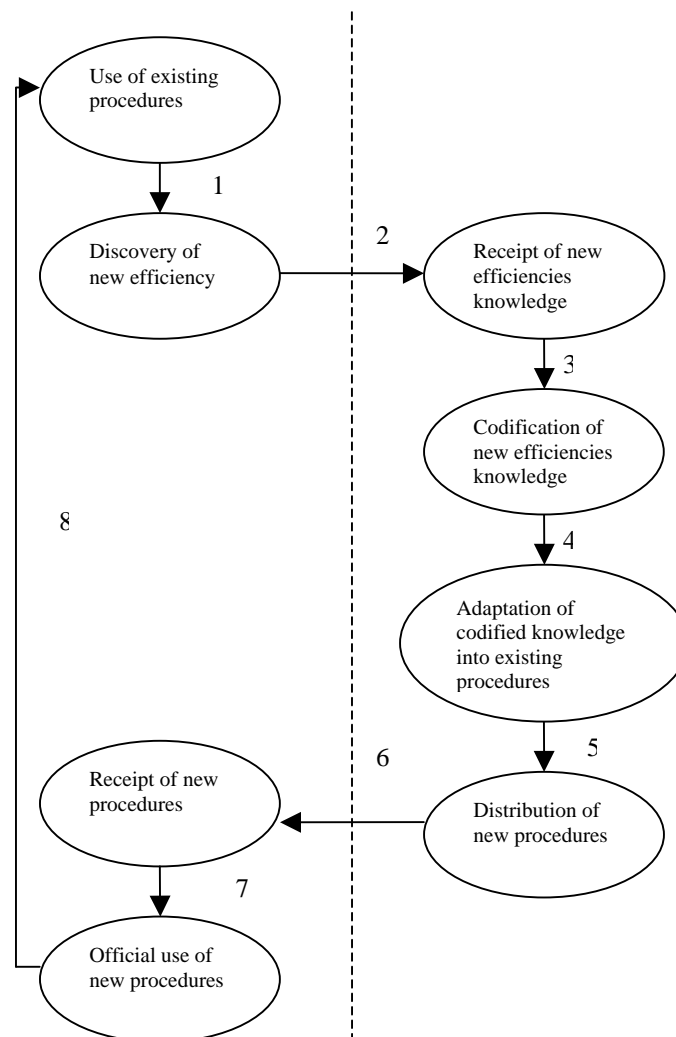


Figure 2 depicts the theoretical approach to knowledge flows between the factory floor worker or their knowledge community and middle management. To the left of the dotted line are processes carried out by the factory floor worker and to the right of the line are processes carried out by middle management. Ovals illustrate processes and numbered arrows highlight usual sequence of bottom-up (see 1-7) and top-down (see 8) knowledge flows.

Figure 2
Knowledge Processes and Flows



3. Research Methodology

We applied a rigorous case study method to collect and analyse our empirical data. In the early stages of theory development into a relatively new research area where phenomena are not well understood and the interrelations between phenomena are not well known, as in this research, a qualitative research approach seems more appropriate than a quantitative one (Parkhe 1993; Yin 1994). Additionally, the research problem dealt with a contemporary topic of effective knowledge transfer that required further clarification, rather than a measurement, of the behaviours and actions of factory workers and middle managers (Carson, Gilmore, Perry & Gronhaug 2001; Yin 1994). Furthermore, we wanted to obtain holistic understandings, explanations and interpretations of particular contextual conditions and situations as well as their meaning by collecting data from practitioners' rich experiences (Gilmore & Carson 1996). In brief, a case method was appropriate.

A case study approach and in-depth interviews were selected as the most appropriate method of research. We selected three large-scale cases to improve the

overall quality and robustness of the collected data. Multiple cases also offered a larger variety of evidence useful for triangulation, analytical generalisation and theory building (Bonoma 1985; Eisenhardt 1989; Patton 1990; Yin 1994). We selected participating metal fabrication manufacturing firms as a result of purposeful convenience sampling. All three firms belong to the same industry allowing us to establish a chain of evidence and to assume a level of analytical generalisation within the findings of the research. All three firms were also similar in size consisting of 200-350 employees in total and a factory floor team of about 30-50 employees. There were also strong similarities in their organisational structure that revealed 4 to 5 layers consisting of the executive level, senior management, (upper and lower) middle management, and the factory floor, as well as a centralised management. Furthermore, all firms were structured along functional areas with the focus of this study being on intra-departmental knowledge transfers within the manufacturing function. The culture within all three manufacturing departments could be described as highly team-spirited one with most employees feeling valued by their firm believing their jobs are important to the success of the firm. Thus employees felt a sense of pride to their workplace. As well, employees were commitment to their co-workers with whom they generally interact on a daily basis in a collaborative work environment in a co-operative manner. All respondents were Australians.

We conducted interviews with selected employees and stipulated certain job functions as the only prerequisite for participants. We selected an interview sample of between 15 and 40 people, which is acceptable to offer a solid basis for analytical generalisation (Eisenhardt 1989; Ruyter & Scholl 1998). We conducted 28 in-depth interviews with respondents from three Australian manufacturing firms, which can be considered sufficient for an exploratory approach.

Two interview protocols were developed to target data collection from factory worker and middle management respondents. In addition, interviews were tape-recorded, ensuring that important statements made during the interviews were not lost. We conducted all interviews with factory workers and middle managers individually to minimise the possibility of biased answers. Each interview followed the interview guide relevant to a respondent's job. In most cases, the protocol was followed during the first part of the interview. However once questions had been addressed, we opened a free discussion to allow participants to add to issues previously raised. Open discussions were recorded to allow our revisiting, probing, and documenting of any relevant data at a later date. The average interview lasted for 30 to 60 minutes.

Table 1 illustrates more details on all case study respondents, their industry experience, years with their current employer and position within their firm. The identities of the participating firms have been changed to ensure their anonymity. However to give readers some point of reference to the activities of these firms, their pseudonyms (Custom Metals Inc., Commercial Metals & Co, Food Service Equipment P/L) reflect the nature of their business activities within their industry.

Table 1
Background Information on Respondents

Years In Industry	Years at Current Company	Interviewees' Title of Current Position
<i>Custom Metal Inc.</i>		
16	16	Production Manager
18	2	Production Manager
33	1.5	Production Manager
11	11	Leading Hand
5.5	5.5	Leading Hand
6	6	Sheet Metal Worker
9	9	Sheet Metal Worker
Not disclosed	Not disclosed	Sheet Metal Worker
40	20	Sheet Metal Worker
<i>Food Service Equipment Inc.</i>		
15	15	Production Manager
15	1.5	Production Manager
22	8	Production Manager
16.5	16.5	Leading Hand
9	7	Leading Hand
30	2	Leading Hand
7.5	1	Sheet Metal Worker
5	3	Sheet Metal Worker
6	2.5	Sheet Metal Worker
8.5	6	Sheet Metal Worker
<i>Commercial Metals Inc.</i>		
12	7	Production Manager
20	15	Production Manager
12	5	Production Manager
7	7	Leading Hand
8	2	Leading Hand
18	18	Sheet Metal Worker
5	3	Sheet Metal Worker
8	8	Sheet Metal Worker
3	3	Sheet Metal Worker

Note: Job Description Key:

Production Manager: Middle management member in charge of the production of a project who liaises with leading hands, upper management, suppliers and customers.

Leading Hand: Sheet metalworker in charge of a team of sheet metal workers. Has the responsibility of liaising with other leading hands on the factory floor and production managers in middle management.

Sheet Metal Worker: Qualified tradesman who works under the authority of a leading hand.

4. Research Findings

The discussion of findings concentrates on the findings of our cross-case analysis that followed a grounded theory approach looking to identify common grounds, match frequently-mentioned patterns, and triangulate categories of similarities and differences between the cases to establish a basis for analytical generalisation (Glaser & Strauss 1967; Patton 1990; Strauss & Corbin 1990). This approach delivered some robust cross-case similarities that were identified to be industry-specific influences. Revealed differences were minor and can be attributed to the differing production methods and environments within the metal fabrication industry in which each of the firms operate.

4.1 Knowledge Discovery

In response to the first research issue, three dominant themes were evident across the three cases within the factory worker community. Firstly, most factory workers considered knowledge discoveries and new efficiencies through trial and error and previous experience or adaptation of information received from others to be the key elements. A Custom Metals Inc. factory worker, for instance, noted that a trial and error approach to knowledge discovery is most common, suggesting 'if you know it didn't work the first time you try another way'. Furthermore, most factory workers stated that previous experience within the context of their current job was very important for the discovery of more efficient processes. Due to the uniqueness of each process and project, factory workers felt that a solid general knowledge of their jobs supported the development of new efficiencies as each new and differing project was approached. A factory worker at Commercial Metals & Co stated that, 'using your experience from previous jobs and adapting that experience to the next job is the most important thing'. This notion is supported by a factory worker from Custom Metals Inc., who stated that the discovery of new efficiencies comes 'from what I've learnt from past experiences'. This belief was echoed by a factory worker from Food Service Equipment P/L who similarly stated that improvements in efficiencies come from 'things I've learnt in past jobs and trying a few ways to adapt these [new processes] to the next job'. In contrast to this, the majority of factory workers expressed that luck and outside work experiences played little or no role in the discovery and development of new efficiencies.

Secondly, some factory workers noted an increase in process 'speed, ease and efficiency' as the main outcomes of knowledge discovery. In particular, four factory workers from Commercial Metals Inc. expressed possible improvements in the final product as an outcome of those new efficiencies. This can be attributed to the unique nature of Commercial Metals Inc. products. Most of the knowledge transferred to and from the factory workers was intended to improve not only the production process but also final product outcomes to help satisfy customers' often unique requests. In contrast, the other two cases produced mainly standardised products. Factory workers from Food Service Equipment P/L, for instance, considered improvements in speed and wastage as the advantages of new processes over original processes, yet the final product would usually remain identical. Giving a reason for unchanged final product outcomes, one factory worker stated 'we make a standardised product so... I look for ways to make the product faster rather than figure out how to build it better. That's the engineer's job'.

Thirdly, middle managers perceived newly discovered knowledge communicated from factory workers only as value-creating when the knowledge was received by a person that could use the knowledge successfully. Evidently, value is not specifically created through the knowledge transfer itself, but rather through the successful articulation of discovered knowledge and possible increased efficiencies and their application, in revised or newly implemented processes and product outcomes.

4.2 Value-Creating Processing of Knowledge in Middle Management

Middle managers perceived their positions as a fundamental part in the facilitation of knowledge exchanges. Primarily, their role was one of a project co-ordinator and link between relevant areas of the manufacturing firm. In addition, most middle managers regarded themselves as leaders and organisers of knowledge as well as catalysts through which knowledge can be distributed purposefully. The following two statements support this view: 'It's my job to get knowledge from the factory floor guys to others like draftsmen, members of our sales team, and storemen so that the business can run smoothly... and more importantly, I have to take knowledge from these people and take it back to the factory floor so production can improve' (Food Service Equipment P/L); and 'I inform leading hands, factory workers, project managers, sales people on the most efficient way of doing things through what I gain from other people [on the factory floor]' (Custom Metals Inc.). That is, middle managers perceived themselves as the main link in the value creation chain by transferring new knowledge in a purposeful way to those people and organisational parts that can utilise it to enhance organisational competencies by applying it and implementing appropriate processes or task-specific changes, and thereby create competitive advantages. Consider a response from a middle manager at Commercial Metal & Co.: 'We meet fortnightly with leading hands to get ideas across from the factory floor, and then we assess them, and if found beneficial, work on implementing changes'.

Most middle managers made no mention of codifying or altering the knowledge transferred in any way, arguing that 'the person who finds the knowledge has a better understanding of it than I do, so I'm in no position to interpret it. I could change it and it may be wrong. My job is just to get it to the person as the sender intended it' (Food Service Equipment P/L). Indeed, not one middle manager made any suggestion about taking information, critiquing and improving it, but rather facilitated its mere distribution. Moreover, a middle manager of Commercial Metals & Co expressed that it was middle managers' role to distribute knowledge among people involved in the product development process such as customers, warehouse staff, factory floor workers and suppliers, stating that 'knowledge of a specific site held by designers, architects or site managers, where our product will be fitted, needs to be passed on to the guys making that product so they can do their job the best way they can and produce a product that is 100% when it is fitted to the site'. Another middle manager from Custom Metals Inc. supported this view: 'We perform a vital link in the distribution of information. If we didn't perform this task then the factory workers would never find out this knowledge and production would not be as efficient... This is where we are adding value to the company'. A common problem expressed by some middle managers

was related to recording and documenting knowledge suggesting that 'previous experiences are rarely documented and mostly stored in our memory'.

4.3 Transfer Methods, Knowledge Articulation and Knowledge Sharing

The hands-on working environment in which factory workers operate, combined with a lack of computer-networked knowledge sharing forums, naturally contributes to the use of predominately verbal communication as being the most preferred method of knowledge articulation and transfer. Utilising verbal communication to transfer knowledge was perceived as easiest, fastest and most effective method. Furthermore, it was the most natural way for factory workers, compared to other forms of communication that do not necessarily lie within their skill base. Thus, the articulation of tacit knowledge into explicit formats rated very low across all cases. In contrast, physical demonstrations of newly discovered processes to colleagues, in particular supervisors, were noted by all factory workers as the easiest way of articulating knowledge within their knowledge community. Demonstration also removed possible ambiguity for the knowledge receiver, as the following two statements confirm: 'You can show someone exactly what you mean and they understand straight away. Plus I don't really have a desk where I can sit down and write it down' (Custom Metals Inc.); and 'our job is hands-on. We don't sit at a desk and write down stuff; it's easier to show the boys what I mean' (Food Service Equipment P/L). In spite of this, a few factory workers stated that by making notes in job documents, leading hands could use them as a reference when planning future jobs similar to those performed previously. However, those documents are often not easily available or retrievable.

Aside from plans, drawings and work orders, personal face-to-face interaction was the prevalent form of communication between the two knowledge communities of factory workers and middle managers. All factory workers felt face-to-face communications were the most effective way to share knowledge due to the specific nature of the knowledge being articulated. One factory worker noted: 'Because of the unique nature of each job, speaking face-to-face to colleagues offers the ability to clearly express what ideas you have and allows the people you're talking to, to give direct feedback'. Promptness was also a factor in the use of face-to-face communication. Several factory workers expressed that knowledge can be transferred faster using verbal and direct communication because 'it is quicker to walk over to the factory floor and have a chat with the guys than write something down, print it out and then deliver it to someone via memo or e-mail' (Custom Metals Inc.). Suggestions of, 'just grabbing someone as they go past' was also offered as a form of interaction to share knowledge. Similarly, most middle managers emphasised a preference for face-to-face communication in knowledge exchanges with factory workers, both in upward and downward knowledge flows.

Most factory workers felt that middle managers were approachable, trustworthy and willing to listen to any ideas they had. On a normal day, interaction between factory workers and middle management would occur several times. However, many factory workers noted that they could only share discovered knowledge on the factory floor with leading hands and production managers, arguing that 'they understand my point of view and where I'm coming from because they've been through it'. This was a common response amongst factory

workers who expressed differing degrees of reluctance to share knowledge with those middle managers who had not been 'through the trade'. That is, unless superiors had been sheet metal workers themselves, had specific knowledge of their job requirements and thus could sympathise with their situation, they were perceived as superiors who were unwilling to listen and talk about ideas. A factory worker from Food Service Equipment P/L believed that 'there's a real feeling about guys who have been through the trade and the guys that haven't. Guys that have been through the trade get what you're talking about. Guys that haven't worked on the factory floor don't'. Most factory workers further elaborated that they would never or rarely share knowledge with managers who had not been through the trade because it was easier to tell someone who had and let them explain it.

In the same way, several factory workers felt an occasional existence of a sub-culture of elitism from some middle managers, resulting in an 'us versus them' culture between factory workers and those middle managers who had no or little experience as a factory worker. A factory worker from Commercial Metals & Co. emphasised this point, noting 'sometimes people who haven't been through the trade don't seem to be really listening to what you have to say because they think that because you're a factory floor worker, what you are saying isn't very good. Therefore the guys from the floor tend to talk to the guys who have been metal workers before, because they respect your ideas and take them on board'. This preferred interaction between 'likeminded' people has caused the majority of knowledge to be passed through one channel, that being through leading hand/production manager interaction, as both usually hold the experience of having been through the trade.

Overall, most factory workers and middle managers stated that they rarely keep new information to themselves if they were of the opinion it would benefit others on the factory floor, in management, or external parts of the firm. When asked about their openness to sharing information with other factory workers, a Custom Metals Inc. factory worker stated that, 'well, all the guys are in the same boat, doing the same job so we need to help each other out. And if someone else finds out something that might help me he'll share it with me.' Almost all factory workers responded to this question with a similar response suggesting a strong feeling of camaraderie within the factory worker knowledge community. Similarly, factory workers expressed a strong group mentality, accentuating that sharing something they know or have learnt to make others perform more efficiently will assist everyone on the factory floor: 'It's more like a group effort, so by sharing something you find, the entire production line gets quicker and everyone gets credit for that'.

Due to the one-dimensional knowledge transfer process and persistence of factory workers to transfer factory floor knowledge only within the expert community, the knowledge transfer process theorised in figure 2, which was developed from the literature and theorised before the data collection, can be regarded as too multifaceted. Figure 3 illustrates a revised model of the knowledge transfer process between the knowledge communities of the factory worker and middle management. Table 2 explains the events involved with a typical example for each of the knowledge transfers in figure 3.

Figure 3
Knowledge Processes and Flows (revised)

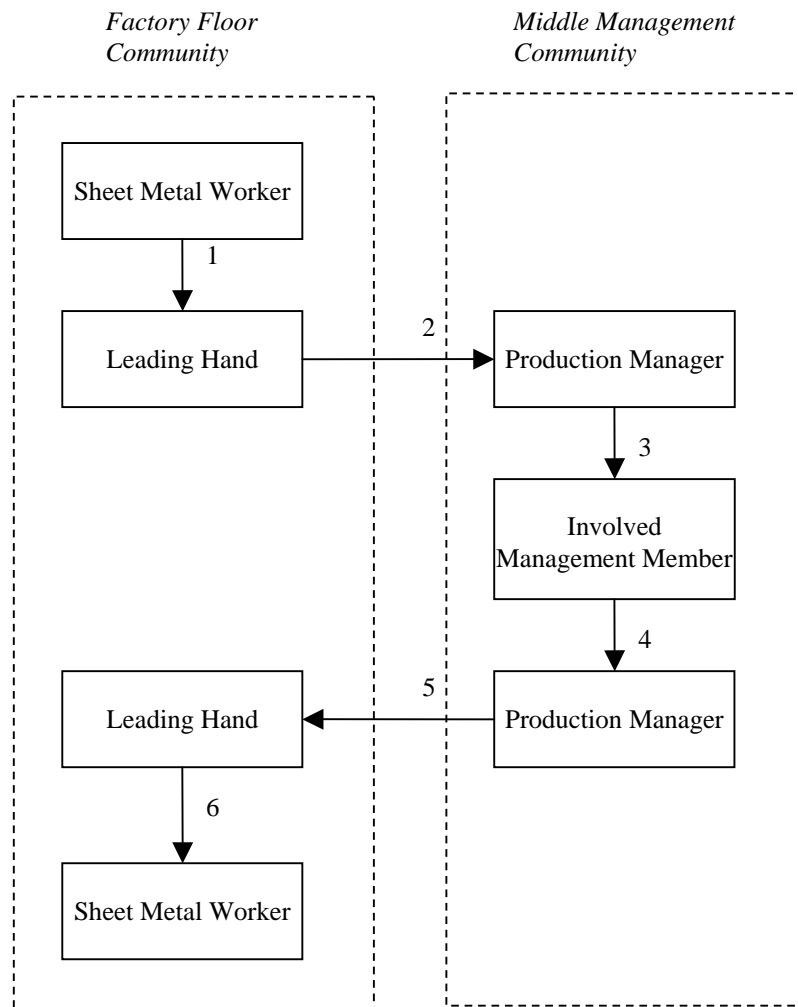


Table 2
Knowledge Transfers of Figure 3

Knowledge Transfer #	Involved Members	Transfer Description
1	Sheet metal worker to leading hand	Sheet metal worker has discovered a new efficiency, tested new efficiency to evaluate if it is viable. Then shares this knowledge with their leading hand
2	Leading hand to production manager	Leading hand appraises new knowledge and if found viable, suggests changes to production manager
3	Production manager to involved member of management	Production manager passes new knowledge to a management member responsible for area of new knowledge
4	Management member to production manager	Once new knowledge is adapted for implementation, management member informs production manager of changes
5	Production manager to leading hand	Production manager passes on new practice procedures to leading hand for application
6	Leading hand to sheet metal worker	Leading hand informs sheet metal worker of official changes in procedure or task

The major difference between figures 2 and 3 lies in their complexity. The findings suggest that the knowledge transfer process is not as complex as theorised in the literature. There is a general perception that particularly the transfer of tacit knowledge is difficult to articulate and disseminate due to its personal and context-specific nature and the common difficulty to formalise, record, codify, adapt, distribute and then apply it. Our findings show however that the degree of difficulty or ease of knowledge processes and flows depends on some mutually understood commonalities and common prior experiences that often seem to exist within a factory worker community and between individual factory workers and leading hands or middle managers such as a production manager. That was particularly the case if they have had prior experience as a factory worker. Such commonalities seem to highly influence relationship strengths within the factory worker community but especially between factory workers and leading hands and the middle management community. Indeed, commonalities seem to enhance factory workers' motivation to articulate newly gained knowledge (Hansen 1999; Martin & Salomon 2003; Szulanski 2000; Watson & Hewitt 2006), for instance minor or major process improvements, within their own factory worker community and leading hands or upstream to middle managers. The articulation is supported by mainly informal socialisation mechanisms that enhance interpersonal familiarity and personal affinity (Björkman, Barner-Rasmussen & Li Li 2004; Gupta & Govindarajan 2000). Indeed, casual interactions are strongly supported by informal team cultures and expert communities of practice that seem to exist within the metal fabrication industry. That is, all factory workers clearly expressed that they preferred to share knowledge within their work environment, but in informal discussions rather than a formalised idea-sharing forum and technology-driven mechanisms. Value creations realised in such informal forums then depend on the absorptive capacity and causal ambiguity of the receiver to recognise and comprehend the potential significance of that process improvement (Cohen & Levinthal 1990; Lippman & Rumelt 1982; Minbaeva, Pedersen, Björkman, Fey, & Park 2003; Szulanski 1996; Szulanski Cappetta & Jensen. 2004; Tsai 2001). Factory workers and middle managers with similar prior industry-specific know-how, familiarity, and experience generally seem to have a higher absorptive capacity leading to less causal ambiguity in recognising the potential value of newly generated knowledge.

5. Conclusion and Implications

There was little prior theory in relation to how people within the factory worker knowledge community discovered new knowledge on the factory floor, and how they shared that knowledge upstream with the middle management community. This research determined that knowledge within the factory floor community is discovered mostly through trial and error and highly influenced by past industry experience and process familiarity. This finding complements Nonaka and Takeuchi's (1995) and Brooking's (2000) work, which proposed that firms generate most of their knowledge through either experience or learning by doing. Further, strong evidence was found to support the literature's suggestion that diverse knowledge communities exist within which people articulate and transfer knowledge more easily (Bechky 2003; Newell et al. 2002). All respondents

expressed a strong feeling of belonging to a community determined by expertise, job tasks, department, and organisational stature, structure, and team culture. The results confirmed that the main activity of those knowledge communities was the articulation and circulation of knowledge between its members, relevant to the job tasks of those members and determined by their field of expertise (Erickson & Kellogg 2003).

In addition, the extant literature suggested that middle management can be seen as a facilitator of knowledge (Ahmed, Kok & Loh 2002; Blumentritt & Hardie 2000; Naisbitt & Aburdene 1985), a view which our findings support strongly. The majority of middle managers confirmed that they perceived their role as a facilitator of knowledge exchanges between factory workers, management that were not part of a certain expert community, and people outside the organisation. However, in contrast to the literature (Hertog & Huizenga 2000; Kessels 2002), we found that middle managers did not codify and process knowledge but merely facilitated its flow and thereby created value.

Furthermore, factory workers essentially transferred knowledge within and between their knowledge communities through one pathway only, that being via close interaction between leading hands, as the spokesmen for a team of factory workers, and production managers. Several studies identified face-to-face interaction as an effective form of knowledge transfer (Barrow 2001; Rumizen & Stemke 2001). However, the literature failed to identify the possibility of knowledge transfer being restricted to one pathway. The results confirmed face-to-face communication as the quickest, preferred and also the only considered way to exchange knowledge between factory workers and middle management as well as within the factory worker community itself. Also, the articulation of tacit knowledge into a more explicit form, storage of knowledge, and electronic distribution of knowledge were neither practiced nor considered to be an option in the near future. Knowledge does not necessarily have to be codified or turned into explicit knowledge to create value. Indeed, most respondents made little reference to documenting knowledge they had discovered, believing however that keeping knowledge in its tacit format could still create value for others and the firm as a whole. The recipient of tacit knowledge, for example, would initially assess possible improvements and benefits to existing officially-documented tasks or procedures by using their personal experience and interpretation on how to best apply the discovered knowledge.

This leads us to suggest that the knowledge transfer process may not always be as complex as theorised in the literature, indicating that the ease of knowledge flows between a source and recipient, such as in our study the factory floor and middle management communities, depends on mutually understood commonalities and common prior experiences. Those in turn, influence relationship strengths between the source and recipient, and a source's motivation to articulate newly gained knowledge (Hansen 1999; Martin & Salomon 2003; Szulanski 2000; Watson & Hewitt 2006). In the case of factory floor workers this articulation almost exclusively takes place through informal social mechanisms (Björkman, Barner-Rasmussen & Li Li 2004; Gupta & Govindarajan 2000). Value creations realised in informal dialogues also depend on the absorptive capacity and causal ambiguity of the recipient to recognise and comprehend the potential significance of newly generated knowledge (Cohen & Levinthal 1990; Lippman & Rumelt

1982; Minbaeva et al. 2003; Szulanski 1996; Szulanski Cappetta & Jensen 2004). Factory workers and middle managers with similar prior industry-specific know-how, familiarity, and experience generally seem to have a higher absorptive capacity leading to less causal ambiguity in recognising the potential value of newly generated knowledge.

Finally, this research discovered a barrier to knowledge transfer previously not mentioned in the literature. Whilst Stevens (2000) outlined the importance of similar experiences to identify expert communities, the literature did not identify lacking job-specific experience as a possible barrier to knowledge transfer. This study demonstrated the willingness of a large majority of factory workers to openly share knowledge with colleagues who had gained no or little experience as a sheet metal worker. As well, because knowledge was found to be shared between members of a specific knowledge community that transcends organisational hierarchies, possible inhibitors to knowledge transfer such as status effect and casual ambiguity (Schermerhorn, Hunt & Osborn 2004; Szulanski 2003) were neutralised and thus barely affected knowledge transfers.

There are several limitations to this study. First, the results are based on only three in-depth case studies in the heavy manufacturing sector, thereby limiting the application of the results to other manufacturing sectors. Accordingly, the findings can only be tentative, are open to interpretation and thus should present a basis for further investigation and discussions. Second, the focus, while empirical, remained exploratory, with key findings drawn from a limited sample of practitioner interviews from Australian workers and managers only. This approach poses a constraint on the external validity and generalization of the results. Third, we did not integrate any outcome measures such as product quality, product success, degree of innovation and market performance into our conceptual model. A deeper understanding needs to be obtained as to how middle managers choose inflowing and outflowing knowledge to generate either little or substantial value to their business unit or the wider organisation. All of these shortcomings imply some avenues for further research.

In brief, this research provides some initial empirical evidence that factory workers prefer knowledge exchanges with those colleagues who have been 'through the trade' and members of the same expert knowledge community. This understanding offers human resource managers valuable information when appointing new staff members and implementing corporate structures that may influence possible bottom-up knowledge transfers within the firm, for instance arranging formal opportunities for knowledge exchange and focusing on employing production managers who have gained prior experience in the sheet metal industry, thus better supporting knowledge exchanges within the expert knowledge community that seems to exist. Secondly, the clear identification of middle managers as knowledge facilitators rather than knowledge creators allows firms to implement knowledge initiatives that encourage this facilitation and appropriately educate middle managers to become knowledge facilitators, thus improving their effectiveness. Thirdly, managers must recognise the existence of diverse understandings and realise the benefits derived from interactions with factory workers. Therefore, firms must provide channels of communication to encourage and support interactions between factory workers and managers. By recognising the preference of factory workers to communicate with management through no-

fuss, personal, face-to-face interaction, firms can implement policies to foster the ease and frequency of those interactions, thus gaining maximum value from knowledge exchanges between the two communities. This may include more time for production managers to spend on the production floor and less time behind the desk as well as less formal encounters to allow employees to interact, such as Friday afternoon barbecues or knock-off drinks.

The conceptual framework presented herein has some managerial implications. The identification of knowledge processes and flows from the factory worker to middle management and vice versa provides a valuable basis for comprehending the nature as well as inherent factors and parameters affecting any knowledge exchanges between the two communities. The successful recognition and development of knowledge process and flows will lead to faster and more purposeful knowledge exchanges which can increase firm-specific process and product-outcome effectiveness resulting in both strategic and financial benefits.

(Date of receipt of final transcript: February 15, 2007.

Accepted by Anne-Wil Harzing, Area Editor.)

References

- Ahmed, P.K., Kok, L. & Loh, A. 2002, *Learning Through Knowledge Management*, Oxford, Butterworth-Heinemann, Oxford.
- Argote, L. 1999, *Organizational Learning: Creating, Retaining and Transferring Knowledge*, Kluwer, Boston.
- Barrow, D. 2001, 'Sharing know-how at BP Amoco', *Research Technology Management*, vol. 44, no. 3, pp. 18-25.
- Bechky, B.A. 2003, 'Sharing meaning across occupational communities: The transformation of understanding on the production floor', *Organization Science*, vol. 14, no. 3, pp. 312-30.
- Björkman, I., Barner-Rasmussen, W. & Li Li, 2004, 'Managing knowledge transfer in MNCs: The impact of headquarters control mechanisms', *Journal of International Business Studies*, vol. 35, pp. 443-55.
- Blumentritt, R. & Hardie, N. 2000, 'The role of middle management in the knowledge-focused service organization', *Journal of Business Strategies*, vol. 17, no. 1, pp. 37-48.
- Bonoma, T.V. 1985, 'Case research in marketing: opportunities, problems, and a process', *Journal of Marketing Research*, vol. 22, no. 2, pp. 199-208.
- Brooking, A. 2000, *Corporate Memory: Strategies for Knowledge Management*, ITP, London. pp. 93-108.
- Brown, J.S. & Duguid, P. 1991, 'Organizational learning and communities of practice', *Organizational Science*, vol. 2, pp. 40-57.
- Carson, D., Gilmore, A., Perry, C. & Gronhaug, K. 2001, *Qualitative Marketing Research*, Sage, London.
- Cohen, W.M. & Levinthal, D. 1990, 'Absorptive capacity: A new perspective on learning and innovation', *Administrative Science Quarterly*, vol. 35, pp. 128-52.
- De Long, D. & Fahey, L. 2000, 'Diagnosing cultural barriers to knowledge management', *Academy of Management Executive*, vol. 14, no. 4, pp. 113-27.
- Eisenhardt, K.M. 1989, 'Building theories from case study research', *Academy of Management Review*, vol. 14, no. 4, pp. 532-50.

- Erickson, T. & Kellogg, W. 2003, *Sharing Expertise: Beyond Knowledge Management*, MIT Press, Massachusetts.
- Garvey, B. & Williamson, B. 2002, *Beyond Knowledge Management*, Pearson, Essex.
- Gilmore, A. & Carson, D. 1996, 'Integrative qualitative methods in a services context', *Marketing Intelligence & Planning*, vol. 14, no. 6, pp. 21-6.
- Glaser, B. & Strauss, A.L. 1967, *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Aldine Publishing Company, Chicago.
- Goh, S. 2002, 'Managing effective knowledge transfer: An integrative framework and some practice implications', *Journal of Knowledge Management*, vol. 6, no. 1, pp. 26-37.
- Goldhaber, G. 1993, *Organizational Communication*, 6th Ed., WCB Brown and Benchmark, Madison, Wisconsin.
- Gupta, A.K. & Govindarajan, V. 2000, 'Knowledge flows within multinational corporations', *Strategic Management Journal*, vol. 21, pp. 473-96.
- Hansen, M.T. 1999, 'The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits', *Administrative Science Quarterly*, vol. 44, no. 1, pp. 82-111.
- Hauschild, S., Licht, T. & Thomas, W. 2001, 'Creating a knowledge culture', *The McKinsey Quarterly*, vol. 1, pp. 74-81.
- Hertog, J. & Huizenga, E. 2000, *The Knowledge Enterprise: Series on Technology Management - Vol.2*, Imperial College Press, London.
- Kessels, J., 2002, 'You cannot be smart against your will', in *Beyond Knowledge Management*, eds B. Garvey & B. Williamson, Pearson, Essex.
- Kramer, R., 1999, *Shared Cognition in Organizations: The Management of Knowledge*, Lawrence Erlbaum Associates, New Jersey.
- Kim, S., Hwang, H. & Suh, E. 2003, 'A process-based approach to knowledge flow analysis: A case study of a manufacturing firm', *Knowledge and Process Management*, vol. 10, no. 4, pp. 260-76.
- Lippman, S.A. & Rumelt, R.P. 1982, 'Uncertain imitability: An analysis of interfirm differences in efficiency under competition', *Bell Journal of Economics*, vol. 13, pp. 418-514.
- Martin, X. & Salomon, R. 2003, 'Knowledge transfer capacity and its implications for the theory of the multinational corporation', *Journal of International Business Studies*, vol. 34, pp. 356-73.
- Minbaeva, D., Pedersen, T., Björkman, I., Fey, C.F. and Park, H.J. 2003, 'MNC knowledge transfer, subsidiary absorptive capacity, and HRM', *Journal of International Business Studies*, vol. 34, pp. 586-99.
- Naisbitt, J. & Aburdene, P. 1985, *Re-Inventing the Corporation: Transforming Your Job and Your Company for the New Information Society*, Futura, London.
- Newell, S., Robertson, M., Scarbrough, H. & Swan, J. 2002, *Managing Knowledge Work*, Palgrave, New York, pp. 109-14.
- Nieminen, H. & Nummela, N. 2003, 'Developing core competencies through knowledge transfer in interfirm co-operation', *Proceedings of the 29th conference of the European International Business Academy*, 10-13 December, Copenhagen Business School, Denmark.
- Nonaka, I. & Takeuchi, K. 1995, *The Knowledge Creating Company: How Japanese Companies Create the Dynamics Of Innovation*, Oxford University Press, Oxford.
- Orr, J. 1990, 'Sharing knowledge, celebrating identity: War stories and community memory in a service culture', in *Collective Remembering: Memories in Society*, eds D.S. Middleton & D. Edwards, Sage, Beverly Hills.
- Ostroff, F. & Smith, D. 1992, 'Redesigning the corporation: The horizontal organization', *The McKinsey Quarterly*, vol. 1, no. 1, pp. 148-68.

- Parkhe, A. 1993, 'Messy' research, methodological prepositions, and theory development in international joint ventures', *Academy of Management Review*, vol. 18, no. 2, pp. 491-500.
- Patton, M.Q. 1990, *Qualitative Evaluation and Research Methods*, Sage, Newbury Park.
- Riege, A. 2005, 'Three dozen knowledge sharing barriers managers must consider', *Journal of Knowledge Management*, vol. 9, no. 3, pp. 18-35.
- Rumizen, M. & Stemke, J. 2001, 'Assessing KM technology choices', *Knowledge Management Review*, vol. 4, no. 5, pp. 22-7.
- Ruyter, de K. & Scholl, N. 1998, 'Positioning qualitative market research', *Qualitative Market Research*, vol. 1, no. 1, p. 7-14.
- Schermerhorn, J.R., Hunt, J.G. & Osborn, R.N. 2004, *Core Concepts of Organizational Behavior*, John Wiley & Sons, New York.
- Spender, J.C. 1996, 'Making knowledge the basis of a dynamic theory of the firm', *Strategic Management Journal*, vol. 17, Special Winter Issue, pp. 45-62.
- Stevens, L. 2000, 'Incentives for sharing', *Knowledge Management Magazine*, October issue.
- Strauss, A. & Corbin, J. 1990, *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, Sage, Newbury Park.
- Sveiby, K.E. & Simons, R. 2002, 'Collaborative climate and effectiveness of knowledge work', *Journal of Knowledge Management*, vol. 6, no. 5, pp. 420-33.
- Szulanski, G. 1996, 'Exploring internal stickiness: Impediments to the transfer of best practice within the firm', *Strategic Management Journal*, vol. 17, Special Winter Issue, pp. 27-43.
- Szulanski, G. 2000, 'The process of knowledge transfer: A diachronic analysis of stickiness', *Organizational Behavior and Human Decision Processes*, vol. 82, no. 1, pp. 9-27.
- Szulanski, G. 2003, *Sticky Knowledge: Barriers to Knowing in the Firm*. Sage, London.
- Szulanski, G., Cappetta, R. & Jensen, R.J. 2004, 'When and how trustworthiness matters: Knowledge transfer and the moderating effect of causal ambiguity', *Organization Science*, vol. 15, no. 5, pp. 600-13.
- Teece, D.J. 1998, 'Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets', *California Management Review*, vol. 40, no. 3, pp. 55-79.
- Tsai, W. 2001, 'Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance', *Academy of Management Journal*, vol. 44, no. 5, pp. 996-1004.
- Watson, S. & Hewitt, K. 2006, 'A multi-theoretical model of knowledge transfer in organizations: Determinants of knowledge contributions and knowledge reuse', *Journal of Management Studies*, vol. 43, no. 2, pp. 141-73.
- Yin, R.K. 1994, *Case Study Research- Design and Methods. Applied Social Research Methods Series, Vol. 5*, rev. ed, Sage, Newbury Park.