Abstract
Research on international transfer of manufacturing capability has traditionally focused on the viewpoint of the ‘transferor’, where the recipient is usually less sophisticated. The nature of knowledge in the transferor is identified as the core determinant of the ‘transferability’ of capability, ideally independent of the host context. In this paper we consider the problem from the viewpoint of the ‘transferee’; extracting the capability that it needs from a relatively passive transferor and feeding back knowledge in a mutual learning system. In such cases the ‘knowledge transfer’ metaphor breaks down. We illustrate this with a case study of a major US computer manufacturer transferring the capability of building its most complex server product to a European site. We discuss the implications of the case for the literature on knowledge transfer and replication. We argue that extractive capability will become increasingly commonplace as receiver plants throughout the global economy become more sophisticated.

Keywords: Manufacturing, knowledge transfer, international management
Abstract

Research on international transfer of manufacturing capability has traditionally focused on the viewpoint of the ‘transferor’, where the recipient is usually less sophisticated. The nature of knowledge in the transferor is identified as the core determinant of the ‘transferability’ of capability, ideally independent of the host context. In this paper we consider the problem from the viewpoint of the ‘transferee’; extracting the capability that it needs from a relatively passive transferor and feeding back knowledge in a mutual learning system. In such cases the ‘knowledge transfer’ metaphor breaks down. We illustrate this with a case study of a major US computer manufacturer transferring the capability of building its most complex server product to a European site. We discuss the implications of the case for the literature on knowledge transfer and replication. We argue that extractive capability will become increasingly commonplace as receiver plants throughout the global economy become more sophisticated.

Keywords: manufacturing, knowledge transfer, international management
Introduction

Much of the recent and current interest in knowledge transfer is focused on the replication of business units in services, such as retail, fast food, hotel and care home chains (Winter and Szulanski, 2001, 2002; Baden-Fuller and Winter, 2004; Banaszak-Holl et al., 2002). This to some extent reflects the trend for manufacturing activities to be relocated away from its traditional centres and away perhaps, from the attention of scholars in those centres. In the US manufacturing jobs have reduced significantly in the period 2000-2003, in the states of California (17% loss), Ohio (22% loss) and Michigan (19%) to name three examples (Bay Area Economic Forum, 2005). However with the movement of manufacturing away from the centre and to the periphery there are still important and unexplored research directions in knowledge transfer.

In the operations management literature the nature of knowledge on the transferor side has been identified as the core determinant of the ‘transferability’ of manufacturing capability (Grant and Gregory, 1997b; Steenhuis and De Bruijn, 2002; Galbraith, 1990). The ideal is for process knowledge to be independent of the host context (Grant and Gregory, 1997a). For consideration of the receiver side of the transfer one needs to refer to the technology and development literature (Bell and Pavitt, 1993; Hobday, 1995; Kim, 1997; Ariffin and Bell, 1999; Figueiredo, 2002). However both fields generally assume a sophisticated transferor with a relatively unsophisticated receiver that is trying to catch-up. In this paper we consider the problems of manufacturing transfer from the viewpoint of the ‘transferee’. Moreover we show that a sophisticated transferee can play an active role in extracting the capability that it needs from a relatively passive transferor. In these circumstances it is possible that the ‘home’ site may be affected by the ‘host’ in that new processes are incorporated into the transferor, so that the learning and upgrading is bidirectional. In such cases the ‘knowledge transfer’ metaphor breaks down.

The paper will argue this case theoretically in the following two sections. The first discusses the operations management and technology and development literature on knowledge transfer in manufacture. The second deals with the literature on organizational knowing, ‘stickiness’ and the current replication debate. The next section illustrates the extraction of manufacturing capability through a case study of a transition in a major global computer producer. In this case capability of a US facility was transferred to a European site. The research design is focused on the recipient organization, the ‘transferee’ and its systematic extraction of the target routines. There is then a discussion of the implications of the case for the knowledge transfer and replication literature, followed by the conclusions. We argue that the case represents an example of extractive capability, which will become increasingly commonplace as receiver plants throughout the global economy become more sophisticated.

Knowledge in International Manufacturing Transfer

Research on international transfer of manufacturing capability in the operations management literature has tended to approach the problem from the viewpoint of the ‘transferor’. In most studies this transferor is the active party, while the receiver or host is usually less sophisticated and plays a passive role (Grant and Gregory, 1997b;
Steenhuis and De Bruijn, 2002). Galbraith (1990) is perhaps typical in characterising the transfer process as “know-how loss” (60) which actually translates as productivity losses when comparing the performance of a recipient plant to the original. Know-how loss is inversely proportional to “resource costs”, which are the pre-planning activities, training, codification and documentation, and “post-transfer control”.

Grant and Gregory (1997b) explore knowledge further than most, recognising that it is neglected in the field. They discuss the options open to the transferor in terms of degrees of adaptation to a “host” context. These range from “cloning” to increasing degrees of adaptation. They explore characteristics of a process for “fit” to host conditions, and “appropriateness”, which pertains more directly to knowledge and capability. These include such factors as labour market issues (Pack, 1981), markets, suppliers, resources, government, interaction with the rest of the corporation, site location attractiveness as well as features such as transportation, utilities and services (Schmenner, 1982).

The consideration of process knowledge arises with factors such as a lack of managerial know-how in the host, “commercial habits”, government requirements and poor Intellectual Property Protection. The sensitivity of a process to any of these factors indicates its “robustness”. Robustness here is used to mean a lack of specificity in application. “If a process was not, for example, climate specific, then it could be considered robust to climate.” (996). On this logic then, implicitly the less specific the process knowledge, the more robust it is to process knowledge in the host. Here we encounter the familiar arguments about the tacitness of knowledge: Tacitness of experiential knowledge “is a function of its speed, contextuality, diffusion, and expressibility” (997). These are properties of the knowledge itself but they also mention resistance to codification from the “owners” of tacit knowledge as something to consider. This is not so much a cognitive variable but an attitudinal one. The level of knowledge is also important, which “is related to the transferor’s experience of using the process and experimenting with it” (Grant and Gregory, 1997b: 997). Again this is discussed as a transferor-side variable. Knowledge-related or attitudinal factors on the transferee side are not extensively considered.

So much of the discussion on the “fit and appropriate for transfer” issue is centred on the process knowledge itself, and the degree to which it is “host-independent” (998):

- A process that can be transferred unadapted to fit given host conditions can be said to be appropriate for that set of local conditions.
- A process that can be transferred unadapted to fit any host conditions can be said to be robust.
- The transferability of a process in its innate, host-independent ability to be adapted (where necessary), transmitted and assimilated, within reasonable time and resource constraints.

Although the level of technical capability in the host is mentioned in the table of factors, the definitions for appropriateness, robustness show that it is the process’s properties that affect its transferability. Where the host is a factor it reduces the transferability of the process. Presumably on this logic where transferability is host-dependence search continues until a host is found that is not a factor. These are demanding criteria, and moreover in spite of the extensive discussion of the transferor
and the process itself it is ultimately the host which determines appropriateness and transferability and the extent to which the process needs adapting or not. The host is the silent partner in this search for host-independence.

Grant and Gregory themselves recognised the idealism and impossibility of host-independent robustness:

“Robust processes can be transferred to any location, and will be appropriate for the local conditions. Robustness is, by definition, host-independent, and can, in theory, be assessed prior to a transfer without knowledge of a host. However, in practice, it is likely that a process will only be robust to a certain set of local conditions, and sensitive to others.” (998)

Several of the configurations of transferability and robustness do not make sense without knowing the level of host capability and how the transfer will be managed. For instance how can a process be assessed as ‘transferable only with host capability building’, when there is no host in question. Implications for transferors are duly included. The case study shows up unanticipated appropriateness problems regarding gaps in capability. In spite of the preparatory process assessment this was frustrated by a lack of consideration of the “softer” issues. These softer issues are the host-dependent factors. The case illustrates that the task is ultimately a specific one, which suggests more attention to understanding the host-dependent characteristics would have been beneficial.

Grant and Gregory extend this discussion on tacit knowledge (1997a) arguing that tacitness is more important than the traditional concerns over maturity of process over a product life-cycle. They argue that a manufacturing process can actually become less transferable as it matures. When considering tacitness to be the key variable, this may increase over the life cycle with the growing complexity of a product. Again the focus is on what transferors should do to mitigate the problem.

As Grant and Gregory (1997b) recognise, exceptions to seeing adaptation from the transferor perspective are generally concerned with transfer into developing countries are (Baranson and Roark, 1985, Cushman and Elenkov, 1994; Ebrahimpour and Schonberger, 1984). Host-dependent factors are discussed in Kim (1980) who relates technology transfer to the development of host technological capability, suggesting the use of host friendly packaging, or piloting capability (Rebentisch, 1993) as well as other factors, that “may impel the transferor to adapt the process to improve its transferability” (998)

IN the technology and development literature, a long-standing stream of research has documented manufacturing organizations in developing countries actively absorbing and learning capability from foreign multinationals operating locally and moving up levels of capability over time (such as Bell and Pavitt, 1993; Hobday, 1995; Kim, 1997; Ariffin and Bell, 1999; Figueiredo, 2002). In many cases cultural and political factors play an important part in the willingness for capability to be developed in the transferee. This literature has shown that transferees can extract capability from technically more advanced transferors, albeit over long periods of time and exposure.
The subtleties of knowledge accumulation in the receiver are explored thoroughly in Figueiredo’s (2002) comparative longitudinal study of two steel plants in Brazil. The study shows how the adoption and performance of particular practices in the receiver affect the level of progressive learning. While studies of this type show the effects on financial performance of the slow accumulation of manufacturing knowledge, this is presented in the context of learning in the recipient and organisational success, rather than the know-how loss of traditional views of manufacturing transfer. For the most part this literature is concerned with receiver plants in Developing Countries attempting to catch-up, so are also dealing with relatively less sophisticated receivers improving and learning over protracted periods of time. What it does not show is effects on the home site. This is perhaps to be expected where the levels of capability begin at such different levels and over time the transferee is attempting to reduce interdependence with the transferor.

The Transfer of Knowledge and Knowing

In the language of Cook and Brown (1999) the typical operations management view of international manufacturing knowledge transfer would fit the epistemology of possession, where knowledge is a disembodied object that may or may not be owned by human beings. To quote Grant and Gregory, “Transferors need to identify where in the process tacit knowledge resides and explore ways of managing its ‘human containers’,” (1997a: 158). Elsewhere they refer to “knowledge owners” (1997b: 997). Cook and Brown’s alternative ‘epistemology of practice’ instead considers knowing, rather than knowledge, which emphasises more the use and application of accumulated skills and competences.

This emphasis on ‘knowledge as practiced’ shifts the problem of knowledge transfer away slightly from the codification/tacitness debate. Where a high degree of practice knowledge –knowing- is shared between a transferor and a receiver this will obviate the need for much of the prompting, demonstration, explanation and codification that would be necessary if the receiver was not familiar with the transferor’s domain of practice. Practitioners with shared understanding typically form communities (Lave and Wenger, 1991; Brown and Duguid, 1991), which becomes a social process of inclusion, with all the associated political delicacies (Brown and Duguid, 2001). Viewing knowledge transfer in this way provides an alternative explanation of the differing success of knowledge transfer between distinct organisations. It raises the issues of differing interests and willingness to transfer.

Studies on knowledge transfer have identified considerable difficulties. Dixon (2000) identifies five types of knowledge transfer: serial transfer within the same team; near transfer to a team in a different location; far transfer of nonroutine tasks; strategic transfer of complex knowledge and expert transfer. Yet for all these types of transfer, there are resisting forces. Szulanski (2003) describes five types of “stickiness” that may be encountered during the phases of transfer; initiation stickiness, the difficulty in recognizing opportunities to transfer and in acting upon them; implementation stickiness; ramp-up stickiness and integration stickiness where the knowledge becomes routinely used by a recipient. Szulanski’s (1995, 1996; 2003) work on stickiness in the transfer of best practice within firms has shown the importance of preparedness and prior knowledge in the recipient of knowledge transfer, or ‘absorptive capacity’ (Cohen & Levinthal, 1990; Zahra and George, 2002) to
successfully receive and process the knowledge. Szulanski argues that an intimate relationship between source and recipient reduces barriers to transfer, but that the capability to receive is crucial.

Szulanski has taken this work forward with Sidney Winter in the current ‘replication’ debate (Winter and Szulanski, 2001; 2002, Baden-Fuller, 2004; Bengtsson and Lindkvist, 2005). Here the interest is in how business units are replicated in corporate chains. Most of the examples given are retail services, such as Starbucks and McDonalds, and the authors distance this lien of inquiry from “traditional” technology transfer- as the latter is usually about transfer of single products and technologies, rather than a system of several in an ‘establishment’ and traditional technology transfer tends to deal with ‘one-offs’, whereas the current debate is concerned with repeated replications over many times, where the interest is in the evolution of the template and the role of the corporate centre with regard to the template or target routine.

Despite all this there is much in this current debate that can inform discussions of one-off manufacturing transfers. The template or target routines are very much akin to the host-independent robust process knowledge of Grant and Gregory. This is not least because in the final analysis context specificities will always make robust knowledge and templates best approximations. Even with a plethora of if/then type contingencies, organisational knowledge can never be completely generalisable (Tsoukas, 1996). In addition the discussion of the template and the role of the centre in the replication literature is highly pertinent to one-off transfers. In the following case study we aim to show why.

The Case Study

This case study was designed to elicit the knowledge transfer activities and behaviours of a large-scale transition in a ‘receiving’ plant. This is an intra-firm transfer in a major computing developer and manufacturer, we call here Compcom. It involved the most complex and high value server product in the company’s wide-ranging portfolio. The product, we call here Powerhouse, is essentially a mainframe. It is used for the central back office operations of large international businesses, such as major auto manufacturers and supermarket retailers. The Powerhouse transition involved the transfer of manufacturing capability from a site in Oregon, to a site in Scotland (SCOT). The goal of the project was to “drag and drop” the current manufacturing operations, reproducing as much as was possible the existing manufacturing operations from one site to other.

Face to face interviews were conducted with 33 managers and engineers spread across the UK and US. The mode duration of interview was one hour. Interviews were semi-structured but aimed to collect data on the broad categories of how the respondents fitted with the transition program and the other team members; what knowledge and experience they contributed and what they learned, what behaviours typically occurred and which tools were used. Interviewees were asked to draw mind maps of their personal communications networks in order to assess where their social contacts were strongest. They were also asked to fill out a quantitative questionnaire aimed at assessing their choice of means of interaction, for example face to face meetings,
telephone or email. The numbers of questionnaire responses were not large enough for meaningful statistical analysis but supported the qualitative interviews in showing the perceived importance of different communications media and forms of contact in proportion to one another. The interviews were taped, transcribed, then coded and categorised in a process influenced by the procedures of Strauss & Corbin (1990). A report was then produced and presented to the industrial participants at a validation workshop, where recommendations were jointly arrived at.

**Background on the Powerhouse Transition**

The Powerhouse F15K is one of the most complex products in the Compcom product portfolio. It is a high-end server and its unit value is between $1-10 million. It is provided to Compcom’s leading customers and it has become an increasingly important product for Compcom, demonstrating the company’s ability to develop complex servers and to support new applications of these servers among its customer base. It also has created opportunities for Compcom to develop solutions packages. As such, the transition for Powerhouse to SCOT is an important event from both Compcom and Compcom Scotland.

The decision to transition the product to SCOT was driven mainly by tax reasons, as well as technical and organisational capability. There were considerable tax advantages to constructing the product in Europe for European customers; this was assessed to be $23m tax savings per year at an initial cost of $13.8m to build the capability- process equipment, infrastructure, air conditioning, power etc. It was also useful to have the flagship product of Compcom constructed on two different sites as a contingency measure and the product draws upon the capability for SCOT site in manufacturing operations.

The case then represents a response to an extension of charter (Birkinshaw and Hood, 1998) for the Scotland subsidiary. The Scottish plant had capability to make the full range of Compcom products with the exception of Powerhouse, the high end ‘flagship’. Since its capability would need to quickly close the gap with its charter the case is focused on the processes and behaviours that effected the knowledge transfer.

**Management Challenges and Response**

At the core of any successful product transition is a strong relationship between the existing and new facility. In the case of Powerhouse, SCOT brought to the process considerable experience with product transitions. For many of the SCOT team, the processes that are followed are similar from product to product, regardless of the product’s level of complexity. Most of the products that are manufactured on site in SCOT involve relatively simple mechanical assembly. “It is like putting together boxes”, commented one interviewee. Both Powerhouse and its predecessor product have a limited number of mechanical parts and in that respect they are similar. However, Powerhouse requires greater software and testing operations. Moreover, there are often bugs in the product that need failure analysis.
This need to debug Powerhouse had a major influence on the factory layout. In the case of a mid-range product, it was not necessary to focus on failure analysis in the design of the factory. Instead, the factory can be organised to increase volume. For example, in the case of mid-range products, only 10% of the products had failures and required debugging activities, whereas for Powerhouse, the number is close to 50%. Powerhouse is also not a progressive line product. It needs to be moved around and shifted from location to location in order to perform failure analysis and debug activities. This creates a need to have more room around the product to allow easy access to it at all stages of the production process.

In the case of Powerhouse, there was some degree of concern, bordering on hostility from the transferor site to SCOT at the beginning of the transition process. Interviewees commented that the transferor site felt that SCOT was a threat to their future of their operations. The transferor plant felt somewhat distant from Compcom’s core operations as they are located at Oregon and they have a history of ownership and operations outside Compcom. They were also concerned that SCOT would provide a low-cost competitor to them, a competitor with considerable tax advantages.

Because the transferor facility had passed through hands of several different owners and therefore some of the practices used at that site were unconventional from the perspective of staff at SCOT. Overall, levels of documentation were lower than for conventional products in Compcom. The transferor site facility also placed more reliance on front-line technicians to resolve problems and debug units than is traditionally done for other Compcom products. These differences were also a source of conflict and learning between the two sites.

In order to ally the fears of the transferor site about the SCOT transition, it was necessary to hold a series of face-to-face meetings among senior managers early in the transition process. Agreement among senior management was only the first step in the process, however. It was also necessary to ensure collaboration at the lower levels of organisation. This came more slowly and depended greatly on personal interactions between front-line staff from the two sites. As we will see, overtime and through interaction, levels of trust and mutual sharing of ideas was increased between the two sites.

From ‘Drag and Drop’ to ‘Mutual Learning’

The original approach of senior Compcom management to the transition was to ‘copy’ or ‘drag and drop’ the production of Powerhouse from The transferor site to SCOT. Yet, there were a number of differences that arose that limited application of a ‘drag and drop’ approach. In effect, there would be a package of changes to production of Powerhouse on both sites. Neither site was left untouched by the transition experience. In total, these changes would also alter the original intention to ‘drag and drop’ and turn the process into one of mutual learning.

The first factor that limited the ‘drag and drop’ approach was the actual location of the factory. It was decided early in the process that Powerhouse was to be built in an existing factory space in SCOT and therefore the production layout needed to conform to the exigencies of this site. This limited the extent to which the exact processes of production could be applied to both sites. Regardless of intention to
replicate exactly from one site to another, Powerhouse would have to fit into this existing site at SCOT.

The second factor was local regulations and requirements. A key element here was the way power was delivered to the workstations. In the US, power was distributed to the workstations via mezzanine. In the UK, health and safety regulations limit the use of this form of overhead electrical supply. The need to conform to local regulations forced a package of changes, each by themselves minor, but in total, they ensured a different set of processes between the two sites. Another example of differences between the two sites was that the workstations used to support the work on each test bed were also different. In the UK, they wanted to use Compcom workstations to allow for remote or un-sighted control. They saw these workstations as “a window onto something” whereas in the US they are used to guide operations. The way materials were handled at the two sites also differs. In the UK, Compcom relies on outside logistics contractors whereas in the US they rely on internal staff.

In order to manage these differences in the process of production, it was necessary to develop an ‘exceptions process’. Every single item that was to be done differently across the two sites had to be documented. The so-called “no-brainers” were agreed at peer-level. However, for more significant changes, there were three reasons for exceptions between practices between the two sites: 1) local health and safety regulations, 2) financial cost, and 3) physical constraints of the plant. Each exception was documented and graded on three-point scale from impacting quality to process change that does not impact quality to “no-brainers”. A joint committee from both sites would decide which exceptions would be tolerated. The agreement between the two sites on this exception process lead to an understanding that the outputs from production from the two sites will be the same, but there would be some room for differences in processes across the sites. For example, the test scripts need to be identical between the two sites and what exits from operations would be the same. The interpretation of drag and drop to the middle managers was “what goes on there does not have to be necessarily the same as long as the key process outputs will be the same.” It would have to be functionally the same, but mechanically different. As long as the outputs are the same, then some degree of modification was allowed into the processes of production.

As one interviewee commented:

The guidelines were as much as possible ‘do a copy’. Obviously, the first thing it makes good business sense. The factory layout does not affect anything else. All the other process steps are identical. The actual way the product is built is identical. It is just laid out slightly different. It is not wildly different. You still plug it in to test it. It’s just you get the plug from somewhere different. Physically to manufacture, it appears different, but it is still does the same core function. All the manufacturing processes that will go in will be identical to the transferor site. All the differences have been ranked and rated and then were agreed to be an exception.

Many of the changes suggested by SCOT survived the exception process because they part of a package of issues related to adapting production to meet local regulations and the needs of fitting production into an existing site. In the end, the manufacturing
cells look different across the two sites, but the tests of the product and product itself are the same.

These adaptations in processes of production between the two sites supported exchange of information and ideas about new ways to organise the process of production for the product. The visits of SCOT staff to the transferor site allowed the staff in the transferor site to see their practices in new light and gain from the experiences of SCOT staff in volume production. It also allowed for greater documentation of the process and development of a number of different practices, both imported from SCOT’s experience with previous Compcom products and also by shared learning between SCOT and the transferor site staff. In effect, the transition was not only a product transition from one site to another, it also allowed for a new thinking about the production of Powerhouse itself. It supported new improvements in manufacturing processes on both sites.

There were two examples of mutual learning between the two sites cited during the interviews. First is related to the adoption of the production metrics from mid-range products to Powerhouse. The SCOT staff argued that the existing metrics for Powerhouse needed improvement in both their quality and display. Through negotiation and dialogue with the transferor site, it was possible to incorporate the metric approach used in the prior SCOT product to Powerhouse. The use of a common metric platform ensured that it was possible to compare performance across the sites, enabling opportunities to find common areas for improvement across the two sites.

Another example of transfer from SCOT to the transferor site was the new common labelling strategy. Previously the transferor site would put a sticker on the front face of the CPU board. Yet, SCOT had found that this label would leave a mark and it was difficult to remove later on in the production process. Instead, SCOT used a Velcro tag attached to the handle. The transferor site decided to adopt SCOT’s approach and together they work together to ensure that suppliers to Compcom in the US to changed their practices.

Alongside these differences in processes, there also some differences between the two locations in terms of training and human resources. In SCOT, there is a strong internal training capability, providing a wide range of training services. Yet the transferor site did not have an internal training function. In order to develop training packages for SCOT, it was necessary for trainers to visit the transferor site and to try to document aspects of the process. Face-to-face interaction was essential for the trainers. The trainers are hands-on, practical people. They need to know the process and product through exposure and experience. They need to “see every minute of the day”. They need to be able to “bounce ideas off people as they are going through the learning experience.” The trainers also used the opportunity to codify some of the experiences and practices of the transferor site. This allowed them to develop a greater understanding of the processes of production and also the problem solving routines used by the transferor site staff on the shop floor.

**Documenting Silent Practices**
A key element in the engagement between the two sites was the documentation of the processes of production. To understand the way the transferor site worked it was often necessary to document practices that were previously undertaken but poorly documented. At the start of the process, SCOT staff videotaped the production process, following the product through all stages of the process. In part this documentation process was necessary to allow SCOT to develop training modules, but it also gave the SCOT staff on their trips to the US an opportunity to write down the process they saw and give the transferor site staff an opportunity to comment on this description of the process. There were some cultural differences between the two sites in the way they approach the process of production. SCOT was seen to be “very detailed-oriented” and they “like to make sure that there are procedures in place.” In contrast, the transferor site had a “lot of individual personalities that are very good at things.” It was necessary for SCOT to make the process of production more “proceduralised.” SCOT were “trying to tap the individual experience that they have there and try to make it something that everybody can use.” However, the goal of the SCOT staff was not to simply document the processes of production in the transferor site. They sought to “augment and provide helpful tools for people in SCOT and the transferor site.”

Breaking down hostility

The Powerhouse transition relied on a high degree of face-to-face interaction via travel by staff to the transferor site facility. In total, five person years were invested on travel for the project. Travel was not limited to senior management, but it was spread throughout the SCOT organisation and concentrated among the manufacturing technicians. Over the five years of travel dedicated to the project, 3.5 years of exposure was linked to the training of 15 technicians. Initially, the first group of manufacturing technicians went over to the US to help meet quarterly targets and they were there when the transition to SCOT was announced. At this point, they were made aware of the concern of the transferor site staff. For the transferor site staff, there was a sense of that the product was “their baby”. As one interviewee stated, “they had building this product for a good few years…They don’t like people coming in and saying you can do this better.”

Driving in the Fast Lane

For these manufacturing technicians, the most important part of the experience of working over in the US was the mentoring on how to test systems and to debug failures. They had the chance to “live and breathe the process over there.” In the transferor site, they operated a “buddy system”, where you would work beside someone and they would “keep in you in the right”. For the manufacturing technicians, face-to-face interaction in the US allowed them to “understand more things”. They argued that there was no substitute for being there and they benefited greatly from the experience. As an interviewee commented, “It is one thing to sit and watch someone do something, but it is totally different to sit at their place and have them watch you.” There was considerable learning from the experience of operation by watching how the transferor site staff responded to failures and debugs. But to really learn the system, it was necessary for SCOT staff to actually be involved
directly in the production. One interviewee said that they were asked “whether they wanted to drive.”

The technicians focused on different problem solving techniques used by US staff. Most of these techniques were not written down. The transferor site staff knew what to do from their own past experience. The production of Powerhouse also involved more manual interaction with the product between the technicians and system. It was necessary for the technicians to do a series of operations, such as manual tests. One interviewee commented that “you have to physically do something to ensure the system was running properly.” Moreover, the role of technicians differed from Powerhouse to the prior product. In the case of Powerhouse, it was the responsibility of test technicians to do both testing and failure analysis. This implied more ownership by technicians of the system.

*Finding Common Enthusiasm*

For the engineering staff that travelled to the transferor site, the trips were more about understanding the process of production. They felt they were able to gain peer-level agreement and then these agreements would be sent up to senior management. Visits to the transferor site were about understanding people and processes, rather than the product itself. Individuals would attempt to see the entire process of production. One interviewee stated: “I would watch that product being built from start to finish.” They would ask: “What happens to it? What tools do they use? How do they move it? Where do they move it? How does that relate to the rest of the factory? How do they get their services to the product – the air, power, air conditioning etc.? How is that designed right through the factory? How would we design our factory to get the same specification?” They used video to try to slowdown the process, to look at people building and assembling it. They did time study of different tasks that could be used to build capacity models. They would go to the shop floor and follow each stage of the process.

The trips were also useful for breaking down the fear of the transferor site staff. One interviewee commented that “if you let them know that you have the same enthusiasm as they do for the product. We are not trying to steal anything or do anything different. We are not going to show them up. It is a partnership.” The transferor site had only made one product and it was a low volume product. For the SCOT staff, the transferor site seemed to lack the discipline of a high volume environment. For example, SCOT staff kept asking for information or documentation about the process that the transferor site did not have. In many respects, this documentation was seen to be unnecessary for the transferor site staff. Often this information was unavailable rather than the transferor site staff not wanting to share it. It was important to develop a mutual understanding of face-to-face consultations to open information flows between two sets of staff. The documentation that was available in the transferor site documented individual processes, but it did not document the whole process of production.

*A Second Pair of Eyes*

There was a tight relationship between the documentation and the face-to-face interaction. For example, it was found that in checking resistance values on a board as
part of the assembly process that a document was out of date. An interview commented,

We were comparing. You know that is different value than on the spec on the document. He said, ‘yeah, this is wrong – the document is wrong’. He knew all the information. She had it in her head. She had a wee book and it had all the correct values in it. But the documentation was wrong. Only because she was diligent as she was could she do her job on a day-to-day basis.

By having SCOT staff examine the processes of production, it added a “second pair of eyes”. SCOT staff were able to see things “that were tripping them up.” SCOT staff could come in and say “I have a wee question for you, why does that happen this way? Oh, right, they would say. If you just did it this way, you could see a big improvement in there.” Once the transferor site realised the benefit of this idea, it would put together a cross-functional team to take the idea forward and implement it on-site. The transferor site staff realised the value of the SCOT staff probing and asking questions about current practices. SCOT were able to bring to the table knowledge about volume manufacture and the benefits of up-front work and semi-finished goods.

Many of the SCOT staff did two sets of trips out to the US. On the second trips, some SCOT staff found that the process had changed. The transferor site had altered the process and the new process was more similar to what was currently done in SCOT. For the SCOT staff, they felt that it was “kind of like a technology transfer” from SCOT to the transferor site. However, they argued it was a “reluctant technology transfer”. One example of how the transferor site process of production had changed from the experience of interacting with SCOT was the way units were pre-tested. In the prior SCOT product, components are tested up-front and then put together for the final product. Powerhouse used to test the system as a whole and this would take considerable time (28 days or so). By adopting the pre-test routine of the established product operations, it was now possible for the transferor site to deliver the product in 8 days because all of the work was done up-front before the product was fully assembled.

The Value of Face-to-Face

Although it was difficult to ascribe a monetary value on the benefits of face-to-face interaction, interviewees argued that it helped to ensure problem resolution. In dispersed working environment “everything would have happened” but “you would probably have more issues on a low scale.” More problems would “pop-up.” As one interviewee commented,

However, the resolution of those [problems are] much easier having met the person face-to-face. You are more inclined to listen to what they have to say rather than being defensive over any points that you are trying. Because you have met them, they get a sense of you.
An interviewee likened the experience of travelling as putting some understanding in a bank, providing a resource that you can draw upon as problems come up. They highlighted the fact that Compcom had been in a position in the past to sponsor a considerable amount of travel. This investment has allowed the company to store considerable understanding and face-to-face relationships in the bank and, that by taking a period of time with limited travel; Compcom could draw down on this past investment. They suggested “that the relationships were already established. You just pick up the phone.” Yet, as Compcom grows, it will again be necessary to build up these personal relationships – to put more capital in the bank.

The face-to-face meetings between engineering staff also made post-travel communication easier. One interviewee stated that

> Once you have a name to a face, then it is easier to put a request to that person. The people know you and they are more likely to come back and give you the answer when you wanted it. Before that, you send an email or call on the phone. If they don’t know who you are, they forget it about quickly. You have got to go back and put in the same request again. But since meeting the people, I have not had to put in any new requests. They now know you.

### Engaging the Centre

A central point of analysis in our study has been the relationship between various teams in a project across different locations. In the case of Powerhouse, manufacturing was located at two locations, yet the design team for the project is located in San Diego. SCOT staff have found that there needs to be high levels of communication between themselves and the design teams responsible for the products they manufacture. The problem SCOT faces is that once the design team has released the product information and material, they move onto the development of the next generation of products. SCOT staff argued that the designers lose interest in the current range of products and offer relatively little support to manufacturing and operations. Given this environment, it is important to have good, personal relations with the design teams in order to gain information and ideas about how best to solve problems that arise in manufacturing. Interviewees found that these relations need to be built up in person and most of the communication does not happen through formal channels.

SCOT is a new player in the Powerhouse product family. In order to include SCOT, it has been necessary to shift the time of the design meetings between the transferor site and San Diego to fit with SCOT work periods. However, SCOT staff is able draw upon its past relations with designers in San Diego. The links were built up through SCOT’s work with other Compcom products. However, SCOT staff argued that it will be necessary to further strengthen these relations in order to ensure that SCOT can respond effectively to problems that arise when the product goes live. One interviewee commented that it is important for SCOT to have credibility with the design group.

Several interviewees highlighted the process they used to build relationships with San Diego. “The product is shipping from Oregon. The power structure is already there
and I have got to get into that and influence it”. The primary focus of the SCOT team has been to transfer what exists in Oregon. Yet, “we are becoming increasingly aware that we need to keep an eye on what is six months ahead because if we don’t, we will find that we are not ready for the next fit.” It is essential to build up relationships with senior people in Compcom and other divisions involved in the product, such as marketing and sales. People on the periphery “will never be privy to the hallway conversations where decisions are made. There is no point in bullying about it and pretending you have influence.” What is more important is to influence people up-front so that they are aware of you and will take you into consideration when they are having the hallway conversations and when decisions are being made. One interview stated that “you don’t get to call the shots based on just where the product is manufactured”. A more subtle strategy is required to gain influence.

Not having opportunities for face-to-face meetings means you “miss the hallway conversations”. It is not about building one-to-one relationships, it is more about having the opportunity to influence people. It is important to have them remember that you are out there. If you are out of the centre SCOT staff argued then you needed to be “visible”. They suggested that there are ways of being visible without having to be there. An interviewee said “that you need to put yourselves in their mind.”

However, well structured a programme, there are still of lot of things that get decided between corridors. It is a pitfall for me. I may agree something with my OPS PM counterpart, and then they literally run into marketing who wants an answer today on whether we are doing a certain thing and sometimes it doesn’t come out of the way you thought you had agreed. You have to be visible both being there and being active. Calling into some of these meetings, just reminding people you are out there. People are receptive. There is no problem there. You just have to keep reminding them.

Discussion

There are several lessons that can be learnt from the Powerhouse transition team’s experience. The first of these is that it is necessary to create a flexible approach to ‘drag and drop’ processes, including an exception process. Product transitions can involve considerable mutual learning between the two sites as they share ideas and experiences about the product. This mutual learning depends on developing a feeling of reciprocity between locations, a mutual recognition on competency and needs of each site. Face-to-face exchanges can help to build the good will trust (Sako, 1992) necessary for successful product transitions (Maznevski and Chudoba, 2000; Orlikowski, 2002; Sapsed and Salter, 2004).

The second lesson from the Powerhouse transition is that peer-to-peer personal exchanges among staff at all levels of the organisation are required for a successful transition. The experience of the manufacturing technicians was invaluable to ensuring the success of the transition and for this experience there was no substitute for face-to-face interaction and actually working on the production process in the transferor site. The technicians had the chance ‘to drive’ and learn from those at the front lines.
The third lesson is that the transition processes involve opportunities for documenting process and practices. It forces one site to upgrade and extend its description of processes and this often involves writing down practices that were previously undertaken but not included in the documentation of the process itself. It also allows for “peer review” of practices. Skilled professionals from the new site can question existing practices and support new ways of working. They can ask difficult questions about why things are done the way they are and they can instigate a process of change at the old site. In effect, the transition processes allows the new site to “shine a mirror” on the production process, and allows both sites to learn from each others experience and know-how.

The analysis shows how the host site negotiated the transition with the home site. The case documents how initially there was reticence from the levels of management below senior level revealing concerns over the threat to the home plant by transferring their capability to a lower-cost facility. The way this was managed by the transferee shows the importance of rigorous processes, political sensitivity, peer-to-peer contact as well as face to face contact. The formal management processes, included a rigorous ‘exceptions process’ in which adaptations to the transfer were categorized and agreed by senior managers. The interpretations of the process differed between levels of management. The Senior Managers involved referred to the transition as ‘Drag and Drop’- trying to replicate the process as faithfully as possible, yet many aspects of the Scottish context required exceptions. At lower levels the ‘Drag and Drop’ metaphor was interpreted to mean implementing the same systems functionally, but mechanically adapting if for legislative or cost reasons.

Conclusions

The transfer metaphor was always a clumsy representation. It suggests speed and ease instead of protracted learning. Nelson and Winter (1982), Kogut and Zander (1992), Winter and Szulanski (2002), Carlile (2004), Nightingale (2004) all recognise that knowledge must be recreated by the recipient, rather than instantaneously transmitted. Knowledge transfer in manufacturing has conventionally been seen as a transferor side problem to do with codification of process knowledge in order to reduce its sensitivity to host specificities. This is probably because most studies are about and assume unsophisticated receivers (typically in less developed countries). Theoretically and empirically we know that host-independent robustness can never be complete and implementation will always be influenced by context. An important aspect of context is the level of capability in the receiver.

The Powerhouse transition shows how it is possible to ‘transfer’ practice knowledge from one of Compcom’s product range to another. SCOT’s considerable experience in volume manufacturing helped to initiate new thinking in the transferee site about how to construct low volume products. The transition process created a two-way exchange between volume and customised manufacturing within Compcom. This meant that there was a bidirectional transfer of knowledge between the transferee and transferee plant. In the language of the replication literature the template was actually owned more by the receiver plant and the transferee, because SCOT adhered more to Compcom prescribed standard procedures. The transfer of Powerhouse is mediated by the template provided by the centre and understood by the recipient, but less so by the transferee/home site. So we have a case of sophisticated receiver and in
some respects relatively unsophisticated transferor, with the outcome that both sites learn and change. The transferor plant, being a relatively recent acquisition was still using routines inherited from its prior corporate history. The receiver plant was representing the centre, in spite of its geographical distance and receiver status in the transfer. This was not the case however for the product design template, which remains elusive and distant to the more peripheral plant.

This is a very different picture than the typical cases found in the operations management and technology and development literatures, primarily because the SCOT plant is a relatively sophisticated receiver of capability, as opposed to a less sophisticated host trying to ‘catch-up’. The case study shows that the proactive approach of the receiver plant belies the passive ‘transferee’ model. The exceptions process, communications behaviour, the systematic training, political sensitivity and judicious use of transporting personnel to enable in situ learning and face to face contact all are elements of what is better described as extraction of manufacturing capability by the transferee rather than transfer. To satisfactorily address a change of charter, subsidiaries must develop the capability needed to deliver on the extended charter (Birkinshaw and Hood, 1998). Extractive capability as demonstrated in this case is a meta-level capability that is required to rapidly assimilate the capability to meet the charter. This is particularly relevant for parent-driven subsidiary evolution, and a proven track record of extractive capability is a useful asset for subsidiary lobbyists persuading the centre to extend a charter.

We suggest this extractive capability is a form of absorptive capacity (Cohen and Levinthal, 1990, Zahra and George, 2002) that will become increasingly prevalent as manufacturing is increasingly relocated away from its traditional centres and as receiver plants become more sophisticated throughout the global economy. The Powerhouse transition is part of a general manufacturing strategy in Compcom where production is being increasingly closed down in the original centre in California and moved out to sites such as the Oregon and Scotland plants. This is in turn should be understood as part of a wider trend in manufacturing. We suggest the extractive features of our US to Europe transition case study will become more commonplace in transitions between Advanced Industrialised Country plants to Less Developed Country plants, such as in China, where advanced manufacturing knowledge is being quickly assimilated. Manufacturing still represents a rich source of research potential and insight, which complements current interest in replications in services. This is particularly so when considering the sophisticated receiver with extractive capability.

References


