

RESEARCH NOTES AND COMMENTARIES

KNOWLEDGE TRANSFER AND INTERNATIONAL JOINT VENTURES: THE CASE OF NUMMI AND GENERAL MOTORS

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Using a case study of NUMMI, a joint venture between General Motors (GM) and Toyota, this research note examines alliances and knowledge transfer with a focus on the organizational processes used to transfer knowledge. The results suggest two possible explanations for the knowledge transfer outcome. The primary explanation is that the systematic implementation of knowledge transfer mechanisms can overcome the stickiness and causal ambiguity of new knowledge. A second explanation is that creating successful knowledge transfer should be viewed from a change management perspective in which trial and error learning experiences and experimentation support the transfer outcome. Copyright © 2007 John Wiley & Sons, Ltd.

INTRODUCTION

This article examines alliances and knowledge transfer using a case study of New United Motor Manufacturing, Inc. (NUMMI), the joint venture (JV) between General Motors (GM) and Toyota. The alliance literature suggests that learning through knowledge transfer is an important and feasible collaborative objective (e.g., Khanna, Gulati, and Nohria, 1998; Simonin, 2004). Knowledge transfer is the process through which organizational units are affected by the knowledge-based experience of another (Argote and Ingram, 2000).

Keywords: alliance; joint venture; knowledge transfer; learning

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Knowledge can be transferred by moving people, specific tools and technologies, routines, and networks that combine people, tools, and routines. Although knowledge transfer in an alliance can occur passively over time, knowledge transfer is an organizational process that can be managed (Nonaka, 1994) and improved upon (DiBella, Nevis, and Gould, 1996).

For organizational knowledge to be internalized, the cause-effect linkages associated with the knowledge must be understood. As a barrier to learning, causal ambiguity arises when managers do not understand the relationship between organizational actions and outcomes (Lippman and Rumelt, 1982). A critical factor contributing to causal ambiguity is the context in which the knowledge was created. When knowledge is tacit and context specific, there may not be a common

language at the recipient unit to use as a basis for interpreting the meaning of the knowledge. The importance of a common language is derived from the argument that knowledge facilitates the use of new knowledge.

THE NUMMI CASE

NUMMI, a JV between GM and Toyota, is an excellent case in which to study alliance learning and knowledge transfer. The narrow scope of the alliance (vehicle assembly only) provided a manageable research site. The evidence of knowledge transfer to GM is the improvement in manufacturing productivity and product quality at GM. In 2002, GM surpassed Ford for the first time in the 13-year history of the influential *Harbour Report's* annual study of North American automobile plant productivity. Also in 2002, GM became the first American carmaker to rank in the top three of the J.D. Power and Associates' annual *Initial Quality Study*, which measures customer complaints in the first 90 days of ownership. GM narrowed the gap between its quality ranking and that of Honda and Toyota. In the J.D. Power report, GM had the top three positions for North American plant quality and the top ranked plant in South America.

A key factor in GM's improved quality is knowledge transferred from NUMMI to GM. According to Gary Cowger, GM VP manufacturing, 'The roots of our improvement is the Toyota Production System [TPS]. We learned from them [Toyota]. We've got to give credit where credit is due' (McCracken, 2001). An executive interviewed for this study referred to NUMMI as the 'guiding light for the improvement in GM manufacturing quality.' Mark Hogan, a senior executive said 'NUMMI has become the centerpiece of GM's efforts to adopt lean manufacturing' (Child, 1998:8).

Data sources and methods

The majority of data were collected in person and via telephone interviews with GM managers. Site visits were conducted at NUMMI, the NUMMI Technical Liaison Office, GM Argentina in Buenos Aires, GM Argentina plants in Rosario and Cordoba (now closed), and a GM plant in the United States. Data were collected in Argentina because Argentina was one of the sites for a greenfield

plant using knowledge transferred from NUMMI. More than 45 current or former GM managers were interviewed along with several outside observers and a number of hourly employees. The GM managers came from various backgrounds; the common thread was a connection to NUMMI and the knowledge transferred from the JV to GM. The interviewees included some of the original GM managers assigned to NUMMI, managers who worked at NUMMI during the period 1984–2002 and managers on assignment in NUMMI in 2002. I also interviewed current and former GM plant managers and corporate level managers.

Following the approach used by Ross and Staw (1993), I consulted published reports on NUMMI and internal GM documents about NUMMI. Published reports established the historical context for the JV and provided evidence to support the validity of the interview data.

A brief history of Nummi

In 1983, GM and Toyota announced a 50:50 equity JV based at GM's plant in Fremont, California, which GM had closed in 1982. Toyota's main alliance objective was countering Honda and Nissan with minimal financial risk and learning to work with an American workforce (Weiss, 1997). GM's primary goals were a small car supply and utilizing an idle plant. Learning was a GM goal but there was no consensus within GM about the value of the learning opportunity (Weiss, 1997). CEO Roger Smith was interested in learning about Toyota's cost structure and how Toyota managed its plants (Keller, 1989). Smith spoke about the JV as a 'learning experience—why not take the opportunity to get an insider's view of how the Japanese do what they do?' (Keller, 1989: 88). Weiss (1997: 292) reported that although GM's finance group favored the deal, GM manufacturing people were 'dead set against a deal with Toyota' and were 'confident in their own capabilities.' Several interviewees said that there was deep resentment within GM about collaborating with a Japanese company. Jack Smith, GM CEO during the 1990s, said in an interview, "NUMMI was important because it set a benchmark... We found out exactly how noncompetitive we were' (Brown and Guildford, 2003: 36).

Toyota had operating responsibility for the plant, which began operating in 1984. The JV agreement allowed GM to contribute 16 managers, or

advisors, to the JV. Within a short period of time, NUMMI productivity and quality were the highest in the GM organization. Total hourly and salaried workers per vehicle averaged 20.8 at NUMMI in 1986, as opposed to 18.0 in Takaoka, Japan, 40.7 in the comparable GM-Framingham plant, and 43.1 at the old GM-Fremont plant in 1978. This productivity difference created a trigger for knowledge transfer.

KNOWLEDGE TRANSFER TO GM

GM's initial investment in learning relied primarily on short visits and the use of GM managers assigned to NUMMI for two years. Initially, these managers, called advisors, were given little training during their rotation and limited preparation for reentry to GM. There was an expectation that the advisors would be able to learn about Toyota and then once reassigned to GM would 'bring back this magic that exists in the Toyota production system' (Keller, 1989: 133). Although these managers were learning as individuals, many became frustrated when they reentered GM because they were unable to implement the ideas they had learned from NUMMI. Within GM there was significant resistance to the Toyota production system (TPS) and a lack of understanding as to how GM could benefit from lean manufacturing. A Toyota executive assigned to NUMMI said GM understood the process 'as far as the hardware and the plant layout are concerned. But I'm afraid that GM upper management doesn't understand the basic concept' (Bussey and Tharp: A1).

By the early 1990s, a viable learning and knowledge transfer system was emerging. A pivotal event was the appointment of Jack Smith as GM CEO in 1992. Smith actively supported learning from NUMMI. Smith was GM director of worldwide planning when he headed the GM negotiating team to form NUMMI. While president of GM Europe (1987–1990), Smith built a team of people who understood lean production, many of them with experience in NUMMI.

The strengthened learning system incorporated various elements. Advisor learning evolved from an ad hoc approach to a structured experience based on a personal development requirement (PDR). The PDR was an educational process involving various stages: orientation to lean manufacturing, plant floor work, required training,

required reading, visits to other plants, and home unit visits. Advisor training was coordinated through the Technical Liaison Office discussed below). Every advisor's learning experience was customized and was supported by a learning contract and a mentor in GM. Advisors were prepared in advance for their reentry assignment in GM, and all advisors were required to write summaries of their learning experiences and implications for GM.

After Toyota's restriction on the number of visitors was abolished, visitors increased significantly. Between 1984 and 1988 there were about 2,000 visitors. Between 1989 and 2002 there were about 21,000. Visits and tours were instrumental in exposing often skeptical, GM managers, engineers, plant workers, and union officials to the fundamentals of the TPS. A Technical Liaison Office (TLO) was established in Fremont in 1985 to facilitate knowledge transfer and influence change in GM. The scope of the TLO expanded over the next two decades to incorporate a wide variety of activities, including teaching and training, knowledge documentation, and consulting services (Figure 1). The TLO supported the transition of TPS tacit knowledge to easily movable explicit task-based knowledge. The TPS also educated GM managers about the potential impact the TPS could have on GM manufacturing.

As of 2003, about 240 advisors had been rotated through NUMMI and about 170 were still with GM. This group of NUMMI alumni played a key role in knowledge transfer and was described as follows: 'We call them advisers but in another sense they are more like missionaries—and we are in need of conversion. It is close to religion, it is a life philosophy, it is that different. It needs a complete change of thinking' (Done, 1992: 23). The alumni were able to teach others about the meaning and value of the knowledge, and as they moved up in the organization, they had the opportunity to exert a greater impact on the learning process.

The knowledge transfer impact on GM

The first major application of NUMMI knowledge was a greenfield site in Eisenach, Germany, where GM opened a new Opel plant in 1992. NUMMI was the model for Eisenach.¹ NUMMI was also

¹ Although NUMMI was the primary model for Eisenach, GM also drew on two other key sources of knowledge about lean

1) GM 2-year assignments to NUMMI (may be extended to 3 years)	6) Executive in residence – 8 months; one executive at a time
2) Study teams focused on learning about a specific task (such as how to build doors); the TLO will design a learning experience of 3 days to 2 weeks; teams must establish an implementation team and follow-up	7) Topical workshops for 3-5 days on topics such as recognition and rewards, and on systems; may be broadcast to other GM sites; 3-5 days
3) Short awareness visits and plant tours (1-2 days)	8) Customer site services; for GM plants or suppliers
4) Short term assignments (2 weeks)	9) Lean Business Solutions Consulting business; mainly for suppliers
5) Summer interns	10) Manufacturing simulation for lean manufacturing

Figure 1. Activities coordinated by the Technical Liaison Office (TLO)

the basis for a major turnaround effort in GM do Brasil. Eisenach was followed by greenfield plants in Argentina (opened in 1997), Poland (1998), China (1998), and Thailand (2000). As the international greenfield plants were built, lean production knowledge levels increased and the network of knowledge expanded. Within North America in the late 1990s, lean production began to impact all aspects of manufacturing. The most visible outcome of the knowledge transfer in the United States was the new Lansing Grand River plant opened in Michigan in early 2002. Old established plants were also being improved and the TPS-based Global Manufacturing System (GMS) was developed as GM's standardized approach to lean manufacturing. GMS was seen within GM as a core competence.

DISCUSSION

This case provides compelling support for the argument that alliances create valuable and exploitable learning opportunities. The case shows that knowledge transfer and the upward movement of knowledge through different organizational levels can be responsive to managerial influence. Over almost two decades, GM exposed a significant number of managers to NUMMI and built

a learning system designed to exploit the learning opportunity. A repertoire of knowledge transfer mechanisms allowed GM to transfer knowledge systematically and continuously. Although in hindsight the mechanisms look quite logical, prior research shows that numerous barriers to knowledge transfer often prevent companies from exploiting learning opportunities (Argote and Ingram, 2000; Inkpen and Crossan, 1995). Had this study been done ten to fifteen years earlier, the conclusion might have been that the knowledge transfer was unsuccessful, when the proper conclusion should have been that the process was incomplete. That said, GM made a number of mistakes in creating a learning environment and learning systems and those mistakes undoubtedly had competitive implications.

Alliances and learning

When a new alliance is formed, information about the other partner and, in particular, information about the managers involved in alliance management will be incomplete. As interactions and the scope for, and the concern over, opportunistic behavior decreases, the partners 'can act as if the future were more certain' (Zajac and Olsen, 1993: 140). As GM learned how to manage its alliance and learned about its partner (which was willing to share knowledge), the value of alliance knowledge became more apparent and the opportunities for exploiting the knowledge were identified, beginning with Eisenach and then spreading to other sites. Over time, GM developed a collective competence in knowing how to capture and transfer complex alliance knowledge. The intent and ability

production: 1) CAMI, an assembly JV between Suzuki and GM in Canada and 2) a team of lean production experts in Europe created through internal and external recruiting (some had worked in NUMMI; others came from Toyota and a GM-Isuzu JV).

to learn from NUMMI shifted from an ad hoc process involving a small group of managers to one shared by many people. The tacit knowledge of the TPS became part of many individuals' shared experiences, which helped create a strategic vision for the company (i.e., that GM needed to become lean in its manufacturing). In turn, the ability to learn became a collective competence that was replicable (e.g., the creation of other TLOs).

NUMMI knowledge made a stronger initial impact in Europe than North America because ties between NUMMI and Europe evolved at a faster pace than they did in North America. These findings validate Tsai and Ghoshal's (1998) study, which showed that different organizational units possess different levels of 'strategic linking capability' that determines effectiveness in using interunit linkages for exchanging resources and transferring knowledge. This study also illustrates the importance of proactively managing knowledge transfer. To develop an effective alliance learning capacity, it is insufficient to merely expose individuals to new knowledge; the intensity of efforts is also critical. Firms must purposefully create knowledge transfer mechanisms to capitalize on alliance learning opportunities.

Understanding knowledge and developing a learning system

GM's experience demonstrates the 'stickiness' of new knowledge (using Von Hippel's (1994) term). Although GM has been criticized for not capitalizing on the learning opportunity faster, GM's experience is validated by other studies of internal knowledge transfer (e.g., Inkpen and Crossan, 1995; Szulanski, 1996). Socially embedded knowledge that is highly context specific and systemic does not move easily (Brown and Duguid, 1998). NUMMI knowledge was tightly connected to Toyota's manufacturing context and was not a random collection of ideas from which GM could pick and choose. For GM to use the knowledge, GM's manufacturing knowledge base had to be modified to be receptive to the new knowledge. Initially, the advisors transferred from NUMMI to GM were poorly prepared. These managers were expected to create a community of shared understanding and practice and were expected to be the 'brokers' (Brown and Duguid, 1998) carrying the message back to the parent. However, rather than brokers

of knowledge, these managers often became itinerants (Gruenfeld, Martorana, and Fan, 2000) with limited influence on the beliefs and norms of the new GM unit to which they were assigned.

GM struggled to appreciate the systemic nature of the TPS. Innovation research suggests that learning about component technology and changes in architecture (interactions across components and often across functional boundaries) require different kinds of organizations and people with different skills (Henderson and Clark, 1990). An organization structured to learn about new component technology may be ineffective in learning about changes in product architecture. GM initially tried to learn about specific elements used by Toyota, such as andon systems and error-proofing stations, and used a learning approach that might have been successful if these elements (or components) were the key to the TPS. In reality, these elements were important tools that could only work if a team-based system was in place and, hence, GM needed to employ a different type of learning system in order to capture the real value of the TPS.

Learning investments tend to be lowest when firms rely on accumulated experience to learn (Zollo and Winter, 2002). GM's initial learning approach relied on what was known and what had been used for years to move knowledge to new plants and geographic locations. As the value of NUMMI knowledge became known and accepted, learning investments were increased and new learning skills were developed. As well, when NUMMI was formed and for the next several years, GM did not know how to create a successful alliance learning system and overcome knowledge transfer barriers. For the small number of managers that initially saw a valuable learning opportunity in 1984, there was no existing learning system to apply to the NUMMI situation.

Organizational processes and overcoming causal ambiguity

This study suggests that a set of organizational processes broke the barrier of causal ambiguity and supported the emergence of a viable learning system for capturing NUMMI knowledge. This system was composed of communication and social interactions via the learning mechanisms, which led to consensus, which resulted in a network effect. The interactions between the various managers exposed to NUMMI created the potential

for individuals to share experiences and ensured that fragile individual knowledge was not lost. As managers interacted, a consensus began to emerge. Consensus building occurred among the initial managers exposed to NUMMI and through increasing the scope (Markóczy, 2001) of consensus. From an initial starting point of a few advisors in NUMMI, the scope of individuals with some understanding of NUMMI expanded to include managers, engineers, union officials, suppliers, and line workers. As a common language around lean production emerged, GM developed what Orlikowski (2002) called an alignment of effort in knowledge building.

Consensus was the antecedent of a network effect within GM. A network effect occurs when individuals in a social network converge in their views and behaviors to the extent that they have proximity and exposure to others in the network (Pastor, Meindl, and Mayo, 2002). The initially disorganized pattern of learning from NUMMI shifted to a more systematic approach as the NUMMI 'followers' (i.e. those that had been exposed to NUMMI and believed in the learning opportunity) interacted and shared their views. Across the GM organization and beyond just the individuals directly connected to manufacturing, there was acceptance that GM had to learn from NUMMI and Toyota. Several propositions emerge from the previous discussion:

Proposition 1: In the early stages of alliance learning, individual learning will have limited impact on the learning partner because there is not yet a consensus about the value of the accessible partner knowledge.

Proposition 2: Once a consensus emerges about the value of accessible partner knowledge, there must be a common language for communicating the learning before investments in learning efforts yield significant results.

Proposition 3: Consensus about the value of partner knowledge and a common language associated with this value are antecedents for the creation of a network effect that supports the transition of disorganized learning patterns into systematic alliance knowledge transfer.

Knowledge transfer as experimentation

A systematic approach to knowledge transfer involving learning mechanisms, consensus, and network building resulted in a successful GM outcome. However, the researcher relying on retrospective reports must be careful not to ascribe rationality and order to what may have been messy, unstructured, and reliant on experimentation. Pascale's (1984) description of Honda's successful entry into the United States shows how the lack of a plan and realistic objectives can provide a platform for experimentation and learning. Honda had no strategy for its U.S. market entry; it had a product and some vague understanding of the U.S. market. Despite this, Honda experimented with its product mix and distribution and eventually became the dominant motorcycle firm in the U.S. market.

Although a systematic process for knowledge transfer eventually emerged, experimentation and trial and error played a key role in the emergent outcome. In GM's case the first few years of the alliance yielded few results in terms of valuable knowledge transfer. However, terming this period a failure is too simplistic and ignores the challenge facing the company. GM did not have a template that could be applied to the NUMMI situation. Knowledge transfer processes had to be invented by GM. In retrospect, several processes, such as ensuring that advisors were properly selected for NUMMI and adequately prepared for reentry to GM, are quite obvious. But, given the lack of understanding that existed about the TPS before the venture was formed, some early mistakes in creating a knowledge transfer system were inevitable.

Significant resistance to change had to be overcome before GM could internalize NUMMI-based knowledge in the company. The process that unfolded embodies some classic change management elements, such as Jack Smith as a change champion, 'early wins' in Germany and the other greenfield sites, experimentation, and a willingness to persevere through the early days of the venture. According to a GM manager, 'We had NUMMI but we had to experiment as to how to exploit the learning opportunity.' This experimentation inevitably meant that some wrong decisions would be made. Experimentation is also necessary to build a continuous learning process. Without experimentation, the TLO and tools like the

PDRs would never have been created. Once the network effect emerged, experimentation became more accepted and the risk-reward tradeoff better understood.

In conclusion, the NUMMI case illustrates some aspects of the dynamics of knowledge transfer. Various questions remain for further research, such as: Which transfer mechanisms are most important and most successful? What factors play the most important role in supporting or hindering the speed of knowledge transfer? How do alliance-partner firm linkages evolve over time? To address these questions and more fully understand organizational knowledge transfer, researchers will need to lodge the research within organizational contexts.

ACKNOWLEDGEMENTS

I would like to express my appreciation to the General Motors and NUMMI managers and employees who assisted me in this project. I would also like to thank Nanyang Business School for supporting me as a visiting professor.

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