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Establishing a high-technology knowledge transfer network: The practical and symbolic roles of identification

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ABSTRACT

Knowledge transfer networks (KTNs) are composed of interconnected firms, government entities, and research organizations that play a critical role in the funding, development, and dissemination of knowledge in high-technology industries. Despite the common use of KTNs in situations that require technology inputs spanning multiple firms, little research has examined the start-up of KTNs and the marketing literature has essentially ignored them. Using social network, social identity, and relevant attribution and motivation theories, the authors build a conceptual model that explains key outcomes of start-up KTNs. A preliminary empirical investigation of a UK-wide KTN start-up finds evidence that social identification with the network is a key moderating mechanism. Identification plays a practical role in creating positive knowledge-transfer benefits for firms that are central in the KTN's social network. Identification also plays a symbolic role by affecting participants' perceptions of overall KTN performance in light of knowledge-transfer benefits that they received, and as an antecedent to affective commitment to the KTN.

1. Introduction

Networks of firms, government entities, and research organizations that share knowledge play an important role in the funding, development, and dissemination of advanced technologies. Moreover, networks of interorganizational relationships spread knowledge across market participants in many industries that produce high-technology end-products (Daniel, Hempel, & Srinivasan, 2002). Because we found no agreement in the literature regarding a label for interorganizational networks focused on knowledge transfer and sharing, we will adopt the term knowledge transfer network (KTN) from practice. KTNs may be formalized, such as an industry R&D consortium (Autio, Hameri, & Vuola, 2004) or Toyota's "knowledge-sharing network" among suppliers (Dyer & Nobeoka, 2000). Alternatively, they can be emergent informal social structures ("social capital networks," Inkpen & Tsang, 2005). For example, a social network of contractual and cooperative alliances links firms in the Boston metropolitan area that are engaged in human therapeutic biotechnology, allowing knowledge to be shared and business transactions to be arranged (Owen-Smith & Powell, 2004).

As *social* networks that cross organizational boundaries, KTNs include not only firms in market channels, but also government agencies, universities, research institutes, "think-tanks," and industry trade associations. KTNs can be critical components of markets because they channel flows of information and resources between entities within a social structure (Owen-Smith & Powell, 2004). Beyond developing and disseminating basic technology knowledge, the benefits of KTNs include transferring best practices, solving specific problems, and developing skills and expertise (Wenger & Snyder, 2000). KTNs are often supported by "flagship" firms that seek to enhance local suppliers' skills to meet the flagship's specifications (Ernst & Kim, 2002) or government and trade groups that hope to improve regional or industry competitiveness (e.g., Groenewegen, 1992). Fig. 1 illustrates the stages through which high-technologies are turned into commercial products (Dutta, Narasimhan, & Rajiv, 1999; Mohr, Sengupta, & Slater, 2005; Moorman & Slotegraaf, 1999; Webster, 1992). KTN contributions to high-technology markets center on technology development and technology application (stages B and C of Fig. 1).

Although KTNs have been a focus of research across various disciplines surrounding technology management and commercialization (e.g., Daniel et al., 2002; Ernst & Kim, 2002; Mowery & Shane, 2002; Owen-Smith & Powell, 2004), two specific gaps in the literature make this topic appropriate for a special issue of *Industrial Marketing Management* focused on the marketing of high-technology products, services, and innovations. First, recognizing that "increasingly, underlying knowledge constitutes a large part of the value" of high-technology products and services, the call-for-papers solicited research on "partnering strategies, strategic alliances, and issues

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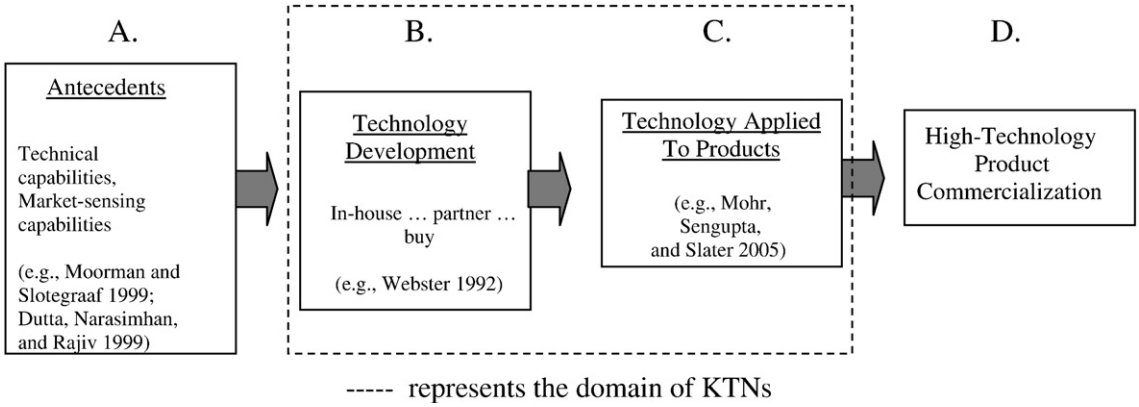

Fig. 1. High-technology product development and commercialization.

particularly pertinent to high-technology firms." Although the *concept* of social network interrelationships for research among firms is an established theme in marketing (e.g., Achrol, 1991), KTNs themselves have been virtually ignored by marketing scholars despite their use in practice and their importance to the development of products and services requiring extensive product or process technology inputs that span multiple firms (see Daniel et al., 2002 for an exception). Marketing scholars have produced substantial research on more traditional cross-firm alliances, involving two or a small number of partners that collaborate for a specific joint action (e.g., co-developing or co-marketing a product), but little research is at the social network level (see Houston et al., 2004 for a review). The IMP Group has contributed heavily to the marketing literature in the area of networks with a focus mainly on buyer–seller relationships (Dubois & Pedersen, 2002). Ritter, Wilkinson and Johnston (2004) and other scholars have broadened the scope of IMP network studies to include interactions with complementors and competitors. In contrast, KTNs extend the notion of a network to be akin to "open-sourcing" within a community of firms, where a network of organizations collaborate for the development of basic technologies and specific applications that can then be accessed by any member. Thus, because of the small amount of network-level research in marketing, much of the literature that we utilize to build our conceptualization is drawn from other disciplines.

Second, even outside of marketing, little research has addressed the *establishment* of the collaborative networks that enhance and disseminate the knowledge-base underpinning many high-technology industries. A study designed to isolate key factors that influence the outcomes of a KTN start-up effort would be valuable to this wider domain of KTN research.

The purpose of this paper is to address these two gaps through insights generated from a study of the launch of the National Composites Network (NCN; see Table 1 for an overview) in the United Kingdom. After a lengthy qualitative inquiry, we collected survey data from 62 firms involved in a KTN. Our central research objective was to isolate key factors — in a theory-based framework — that impact important KTN outcomes at both the firm level and the social network level. The remainder of this paper is developed as follows. First we provide a cross-disciplinary review of the literature that serves as a foundation for our model of KTN performance. Next, we present a conceptual framework for understanding KTN performance using the individual firm representative as the unit of analysis. Our ultimate goal is to explain actual KTN performance outcomes, but early in the life of a KTN, when our study was conducted, no objective performance measures are available. As a result, we rely on self-reported perceptions of key informants who are also the principal actors in the KTN on behalf of their firms. Third, we describe our exploratory, multi-method examination (qualitative interviews, social network data, and traditional survey data) of key factors that drive individual perceptions of KTN performance. Our study was conducted over a one-year period as a KTN was planned, organized, and launched (see Table 1). Perceptions of performance were collected at the *individual/firm* level (e.g., my firm has received knowledge-transfer benefits from involvement in the NCN) and at the *network* level (e.g., the NCN is accomplishing what it should given its level of development).

Table 1
The National Composites Network (NCN)

In mid-2004, the United Kingdom (UK) government's Department of Trade and Industry (DTI) announced that a new "knowledge transfer network," focused on high-technology composite materials[a] would be launched. The network would bring together representatives of end-product manufacturers (ranging from aircraft giants, to boat builders, automobile manufacturers, and medical product makers), suppliers of raw materials and components, as well as academic and industrial researchers, to share existing knowledge and create new technical knowledge related to composites (from basic scientific knowledge to specific processes). As one industrial researcher noted, "The [leading end-product manufacturers] are driving a move toward composite technology, but the supply chain is not in step." An executive from a large end-product maker clarified this view: "We must engage a far wider spread of [cutting edge composites abilities] throughout the supply chain, down to the [small suppliers]. Many are metal-bashing types of outfits that must educate themselves if they wish to stay in this same market."

Because composites were forecasted to gain an increasing proportion of production share, the DTI had a primary goal of protecting and creating jobs for the UK by improving capabilities throughout their country's supply chain for composite materials. Recognizing that world-class capabilities existed within individual firms and research centers in the UK, the DTI desired to create a mechanism by which disparate participants could both share and learn from others, thereby transferring knowledge and skills across the supply chain. With world-class abilities, UK suppliers would find increased demand for their composites as UK end-product manufacturers could rely more heavily on local firms for inputs, and global firms would see UK suppliers as viable sources to fulfill composite needs. Thus, end-product makers had motivation to participate in order to improve the capabilities of their supply chains, and firms across the supply chain wanted to be involved in order to acquire in-demand knowledge and skills that would help them increase sales. Thus, to great anticipation, the National Composites Network (NCN) was launched as 2004 came to a close.

In interviews with key participants surrounding the launch of the NCN, three themes emerged. First, to be seen as legitimate, the NCN had to deliver "early wins," which the interviewees defined as "real" knowledge-transfer benefits to firms across industry boundaries. Second, participants had to be engaged in and committed to the NCN; not just the large end-product firms, but even the small suppliers. One leader noted, "If people are not engaged, they feel disenfranchised and will interfere or rubbish the NCN." Third, key participants and leaders must be retained, as "defection could cause big problems."

[a] Composites are high-technology, hybrid materials created by the combination of several different basic materials (e.g., plastics, fibers, metals, ceramics), and designed to offer superior structural properties (e.g., increased strength, enhanced breakage resistance, reduced weight, better thermal properties) compared to traditional materials. Examples of composite material applications include carbon fiber used in the upper echelons of bicycle racing frames, metal matrix composites used in the landing gear of the F-16 jet aircraft, the Toyota 2ZZ-GE engine block and automotive disk brakes, and ceramic matrix composites used in extreme high-temperature environments like rocket engines.