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Necessitated absorptive capacity and metaroutines in international technology transfer: A new model

Patrick van der Heiden[a,*], Christine Pohl[b], Shuhaimi Mansor[c], John van Genderen[d]

[a] MVI International B.V., Schoolstraat 50, 1719 AW, Aartswoud, The Netherlands
[b] Institute of Computer Science, University of Osnabrueck, Barbarastr. 22b, D-49076, Osnabrueck, Germany
[c] Aeronautical Engineering Department, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Johor, Malaysia
[d] Faculty of Geoinformation Science and Earth Observation, University of Twente, 7500 AA, P.O. Box 6, Enschede, The Netherlands

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ABSTRACT

International technology transfer of advanced technology and knowledge and their subsequent absorption is crucial to firms in developing nations. This research paper aims to further enhance the understanding and operationalization of the absorptive capacity construct. In the rigorous review of existing literature, organizational routines were found to play a significant role in enhancing an organization's absorptive capacity. We present our conceptualization of necessitated absorptive capacity as a dynamic organizational capability in the Necessitated Absorptive Capacity model. This paper contributes to the existing literature by providing a new model and an enhanced understanding and further operationalization of absorptive capacity.
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1. Introduction

International Technology Transfer (ITT) is a major player in obtaining return on public investment in research and development (R&D). In addition it stimulates innovation in business and commerce and contributes to economic growth (Venturini and Verbano, 2014). Nahar et al., 2006 define ITT as the "process by which a technology supplier communicates and transmits the technology through multiple activities to the receiver, across national borders (2006: 664)". Their holistic approach perceives ITT not as a singular event (i.e. the actual transfer of a particular technology) but rather as an elaborate process starting with identifying needs and demands for technology, the activities pertaining to the transfer and implementation leading towards the assurance that the recipient has acquired the technology as initially intended. The process of technology transfer (TT) exists in two basic forms according to Hall and Johnson (1970): the transfer of physical

* Corresponding author.
E-mail addresses: patrickvdh30@gmail.com, heiden@mvii.nl (P. van der Heiden), chripohl@uni-osnabrueck.de (C. Pohl), shuhaimi@mail.fkm.utm.my (S. Mansor), genderen@alumni.itc.nl (J. van Genderen).

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items (machinery, tooling, process information, specifications and patents) and personal contact among individuals or groups of individuals in organizations (e.g. product-embodied or person-embodied). A useful taxonomy of TT can be drawn from Reisman (1989) perceiving TT as the process by which a particular technology is communicated and transmitted through various activities by a technology supplier to a receiver. The receiver's technological capability may be enhanced as a result of TT. Petroni et al. (2013) synthesize TT in six main phases: (i) technology gap identification; (ii) technology source identification; (iii) technology selection; (iv) technology supplier selection; (v) TT contracting; and (vi) technology adaptation. It is important to point out that the actual transfer process may take place between a wide variety of different entities and individuals in the international scientific, commercial, industrial and developmental realms and across geographic regions, societies and nations. ITT and absorptive capacity (AC) within the international commercial realm constitute the contextual nucleus of this paper. Where applicable, differentiations are made in order to distinguish between the various realms and to identify the actual actors within the ITT process. Although ITT between nations occurs as part of developmental aid or assistance (Hoekman et al., 2005), when references are made to ITT between nations in this paper, these constitute the agglomeration of economic activities between firms acting as either technology transferee or recipient within these nations.

ITT of aerospace technology or information technology (IT), for example, envelops the transfer of advanced technology, which is innately characterized by a degree of technological complexity. Technological complexity is defined by Meyer and Curley (1991) as the depth and scope of the programming effort, the user environment, and related technical efforts involved in building such systems and in implementing them in production environments. The distinctive advanced state of such technologies can be translated to what Nahar et al. (2006) have defined as a high technology. This requires high utilization of scientific and engineering manpower and extensive R&D expenditure, thus placing it at the forefront of technological leadership. As the complexity of a technology increases, its subsequent transfer proves more difficult (Kogut and Zander, 1993). The extent to which technologies are specific or generic is deemed important as the potential of TT depends significantly on the generic aspects of the technologies (Bach et al., 2002). The movement of technology to another organization of interest and its utilization often proves to be a complicated and unsuccessful organizational task (Stock and Tatikonda, 2000). Radosevic (1999) pointed out that "the complexity of technology and the ensuing difficulties in approximating various types of technology flows are pervasive (1991: 30)" and concluded that the analysis of TT should be eclectic in order to address the multidimensionality of technology. Ambiguity still exists with regard to the terminology and understanding of terms such as ITT, diffusion of technology and the parameters involved in the transfer process. Technology itself is ambiguous because technologies are tacit, specific, and complex. It refers widely and is susceptible to multiple interpretation (Powell et al., 2006). It may thus leave room for ambiguity aversion to play an important role in the absorption process (Bryan, 2010).

This review paper does not attempt to serve as an exhaustive review on alternating conceptualizations of (high/advanced) technology, ITT and AC but rather aims *ab initio* to build and propose a conceptual model of AC in an effort to operationalize the AC construct. This exploratory work contributes to existing literature by providing an enhanced understanding of AC as part of wider research into the role of AC to Less Developed Countries (LDC's) and Newly Industrialized Nations (NIC's). In fulfilment of this paper's central premise, the conceptualized Necessitated Absorptive Capacity model endeavours to operationalize the AC construct and enable managers of LDC and NIC firms engaging in cross-border technology transfer to utilize the model as a template to translate necessitated AC into a set of concrete actions and adjustments in pursuit of the organization's strategic goals. In addition, the proposed model aspires to allow for structured analysis of necessitated AC, its constitutional elements and the intricate role organizational routines play in the AC metaroutines cycle. Lastly, the paper raises continued awareness among researchers and the international business environment alike for the perpetuated obscured usage of the concepts of (advanced) technology, ITT and AC in academia and business practice as its implications continue to impede theoretical contemplation and research as well as the execution of ITT-projects by firms engaging in cross-border technology and knowledge transfer.

2. International technology transfer

The extend of ITT activities expounds differences in per capita incomes between countries (Acharya and Keller, 2009). ITT constitutes access to overseas markets, expanded production possibilities, conceivable stronger political influence for the transferring country and means for infusion of advanced technology, creation of job opportunities and rapid economic development for the recipient country (Fan and Yu, 1983). Over the past decades ITT has matured to be an important research field (Al-Obaidi, 1999; Johnson et al., 1997; Robinson, 1988) and has stimulated considerable interest among academic researchers, policy-makers (Bozeman, 2000) and practitioners (Petroni et al., 2013). ITT's basic model was conceived in the 1970's and 1980's. Four factors determine the effectiveness of technology and knowledge transfer, namely: (i) goals of the knowledge-administering entity; (ii) its proficiency of mastering knowledge transfer; (iii) aims of the knowledge recipient and their ability to incorporate the new knowledge and (iv) its (organizational) learning (Liefner et al., 2012). ITT has transformed from a rather one-sided transfer process of expertise, equipment and funds from a developed country (DC) to a LDC, characteristic of the 1970's and 80's (Hoeke and Irsyam, 1983; Specter, 1989). Since the early 1990's, the transfer of technology has increasingly become a two-way affair, with scientific and commercial entities in both countries contributing to the international collaboration (Hoekman et al., 2005; King and Nowack, 2003; Petroni and Verbano, 2000; Rogers et al., 2001).

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