VNU Journal of Science: Economics and Business, Vol. 36, No. 5E (2020) 1-10

VNU Journal of Science: Economics and Business

Journal homepage: https://js.vnu.edu.vn/EAB

Original Article

How Do Intermediary Organizations Support SMEs to Enhance their Absorptive Capacity?

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Received 01 December 2020
Revised 07 December 2020; Accepted 20 December 2020

Abstract: Researchers have discussed intermediary organizations as the crucial facilitators of technology transfer in an innovation system. They employed the intermediary term in different settings in the innovation system literature. In past decades, scholars highlighted the importance of intermediaries repeatedly. However, few studies examine intermediaries' role in the innovation system. In this paper, we underline the significant role of intermediaries in boosting absorptive capacity in small and medium-sized enterprises by introducing a framework that expresses intermediaries' functions and their services in absorptive capacity as an essential element of successful knowledge and technology transfer.

Keywords: Innovation System, Intermediary Organizations, Intermediary Services, Absorptive Capacity.

1. Introduction

Countries have accelerated economic growth by promoting innovation. Hence, academics have presented the term 'innovation system' to explain ecosystems in which innovation occurs [1,2] and have expanded the term in the literature [3-6]. The innovation system theory indicates that innovation occurs by interaction among various actors who exchange knowledge and technologies and actors who support the exchange process. Thus, innovation does not happen in isolation. Ortega-Argilés et al. [7] mention that this exchange is vital for SMEs. However, knowledge or technology transfer is a complex phenomenon, and it does not lead to innovation if the transferred knowledge or technology has not been fully absorbed and utilized. The literature demonstrates that to absorb technology enterprises need to develop their absorptive capacity. Such capacity development would require resources and time and therefore SMEs compared to large-sized companies, encounter more difficulties in such process. Moilanen et al. [8] explain the effect of collaboration between non-R&D SMEs and National R&D institutes (e.g., Universities) on the absorptive capacity of SMEs. They state services of the R&D institutes can assist firms in developing

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https://doi.org/10.25073/2588-1108/vnueab.4456

their absorptive capacity. Hence, it is essential to perceive how intermediary organizations within an innovation system can assist such capacity development processes in enterprises.

In this paper, we discuss the gap in grasping the intermediaries' contributions in developing absorptive capacity in firms, especially in SMEs. In addition, we attempt to generate a typology and a framework that explains the functions of intermediaries organizations within four dimensions of absorptive capacity. We believe that implementing this framework, especially in developing countries, equips researchers and policymakers with a benchmark that helps them understand the SMEs' demand in terms of external services essential to enhance different dimensions of the absorptive capacity of their firms.

2. Innovation Systems

Between1960s and 1970s, institutions like the Organization for Economic Co-operation and Development (OECD) realized research systems in countries could impact their economic growth. However, it was not clear how different research systems can lead to different economic growth rates.

The authors endeavored to conceptualize this finding systematically. In the 1980s, Christopher Freeman and IKE-group published a study that made a significant contribution in establishing a concept for this phenomenon [1, 2] by a) demonstrating an insightful outline of the innovation process, b) contributing to "national production systems" and "industrial complexes" concepts and c) clarifying what significant vertical linkages are in innovation outcomes [9]. Afterward, Freeman [10] and Lundvall [11] expanded the 'national innovation system' concept in the economic literature. Ever since, researchers have broadened the concept and discussed innovation systems, not only in the national context but also in other contexts, e.g., technological [3], regional [12], and sectoral [13]. Hence it was essential also to explain the interaction between the actors of such system in each context. The "Helix system" concept was one of the first attempts to clarify such interaction in the innovation system theory. The helix classification seeks to describe communication, networking, and institutional arrangements in an innovation system.

Etzkowitz [14] and Leydesdorff [15] suggested the main interactions in an innovation system occurs among three main actors (university, industry, and government). Therefore they proposed the Triple Helix-concept to illustrate the interactions among these actors. They mention that the triple helix pattern (in which hybrid organizations connect university, industry, and government) is the ideal setting of an innovation system. They emphasized that the statistic model (in which the government controls university and industry) and the laissez-faire model (in which there is a distinct borderline among university, industry, and government) are not optimum.

Following Etzkowitz and Leydesdorff, various scholars have sought to expand the helix system model by considering new actors. They generated the "Quadruple Helix" model in which the market (society, media, etc.) was added as a new sphere [15, 16, 17] and discussed possible other actors that could be counted in the Helix model. Nevertheless, they did not clarify whether intermediary organizations can be added as an important actor in such a model.

3. Absorptive Capacity

To produce service and products and be competitive, firms require resources and capabilities which they can utilize to increase their productivity and profitability [18]. To increase competitiveness, firms are forced to acquire resources and capabilities to enhance their efficiency and profitability [18]. Hence, Wernerfelt [19] introduced the '*Resource and Capabilities Theory*' to explain such dependency. Later, others elaborated on this theory [20,21,22]. The theory emphasizes that companies should own specific resources and

capabilities to become more competitive compared to their competitors in the market [18]. Although this might be a possible task for large-sized enterprises, it is more challenging for SMEs to obtain resources and capabilities due to lack of financial and human resources. Hence, SMEs tend to count more on solid and low-cost exterior know-how rather than on their own R&D activities in their innovation activities [23]. However, SMEs who can flexibly adapt external knowledge have a competitive advantage in comparison with large firms that are usually bureaucratic and rigid [7]. Researchers [24,25] believe Absorptive Capacity (ACAP) can be determinant in the process of adapting external knowledge in firms. They also propose that ACAP can impact SMEs' responsiveness [26] and their cooperation with other institutions [27].

Since the 90s, many scholars have investigated ACAP. In 1990, Cohen introduced ACAP to the literature in social sciences and economics. Thenceforth, scholars have contributed to advancing the concept and utilizing it [28]. Since the concept emerged, scholars have examined it as a factor that influences R&D success [29,30,31], networking [32,33], innovation [34,35] and performance [36,37] of firms.

Cohen and Levinthal were the architects of the ACAP definition. They interpreted ACAP as *"[...] an ability to recognize the value of new information, assimilate it, and apply it to commercial ends"* [30, p.128]. They defined ACAP as an organizational capacity that is associated with behavioral and learning science fields. They emphasized that ACAP is *"[…] the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge"* [30, p.128].

Contrarily, Zahra and George [38] consider ACAP as a dynamic capability. They believed that the ACAP concept needs to be reformulated. They defined ACAP into two main sub-elements: *potential capacity and realized capacity*. The potential element contains two dimensions: the *"acquisition"* dimension, which was created by Zahra and George, and the *"assimilation"* dimension, which was created by Cohen and Levinthal [30] previously. The realized element also contains two dimensions: the *"transformation"* dimension that Zahra and George suggested as a new dimension, and the *"exploitation"* dimension, which was already mentioned by Cohen and Levinthal [30].

After Cohen and Zahra, various scholars adapted or restructured the ACAP concept. Nevertheless, no concept is generally accepted in the literature, and therefore authors restructure the concept to fit it to their research setting [28]. In our literature review, we found that the four-dimensional concept is the most common design in utilizing ACAP in economics studies.

3.1. The Role of Absorptive Capacity in Technology Transfer Success

Zahra and George [38] and others have studied the concept of ACAP and its co-relationship with various elements (e.g., innovation performance and firm's performance) that affect the growth of enterprises [29,35]. The majority of studies examined the role of other organizations (e.g., intermediaries) in ACAP development. Furthermore, literature typically reviewed ACAP in a knowledge management or organizational domain, and very few research works analyzed ACAP in the technology transfer domain [28].

Those who explored absorptive capacity in the technology transfer field tend to study ACAP as an organizational capacity with mediating impact on technology transfer [39, 40], obtaining the external and internal technology [24,25] and innovation performance (containing new product development, commercialization, organizational innovation, etc.) of companies. These researchers believe that ACAP affects organizational or product innovation performance by influencing employees' and executives' performance to identify technology transfer possibilities and conduct successful technology transfer activities.

3.2 Absorptive Capacity Determinants in Technology Transfer

Mowery and Oxley [34] suggest that investments in training, competitive policies, technology transfer channels, sector-specific support, and trade restrictions impact the ACAP of enterprises in an innovation system.

At the firm level, scholars mentioned various factors directly or indirectly related to the firms' R&D activities. These factors are R&D efforts [41], FDI [42], knowledge extent and R&D centrality [43], use of IT [44], and market competition intensity [45, 46] as the factors impacting the ACAP of a firm. Another critical factor that scholars consider influential on a firm ACAP is the firm's size and age. Shleifer and Vishny [47] discover that once firms become public, their R&D investment decreases, and therefore it negatively affects their ACAP. However, Zou et al. [48] conduct a meta-analysis and find that ACAP and a firm's size and age do not have a direct positive relationship in all cases, and it can change in different stages. They suggest that in small firms, ACAP has a positive and significant relationship with the firm size. But once the firms grow or become mature, their ACAP does not increase necessarily. Finally, internal factors such as employee skills and motivation [49], firm efficiency, scope, and degree of flexibility [50] impact ACAP in firms.

4. Intermediary Organizations

Scholars have used the intermediary term in different concepts. Howells [51] categorizes intermediary research into four fields, technology transfer and diffusion, innovation research, NIS, and service organizations. But, the concept is still broad, and there is no unique definition for the term. In his study, Howells addresses 23 terminologies and definitions used to describe these actors. Researchers discussed intermediaries from two perspectives: organizational and functional [51]. The first view aims to distinguish the types of organizations that act as intermediaries in an innovation system. The second view emphasizes the functions of intermediaries and their role in the complex process of innovation. Howells [51] reviewed the innovation system literature on the intermediary term since the 1980s. In his study, Howells indicates that authors used various names in describing intermediaries, e.g., third parties [52], brokers [53] innovation intermediaries [54], regional institutions [45], and etc.

4.1. Intermediaries in National Innovation Systems

Watkins [56] describes three shifts in which the intermediary term was merged and developed in the literature of the National Innovation System (NIS). The studies in the first shift (starting from 1982) discussed a few types of intermediaries (including knowledge and network intermediaries, research councils and funding bodies, etc.) without explaining the functions of intermediaries and their role in NIS. In the second shift (starting from 1995), literature introduced more intermediary types (including industry associations) and various roles of intermediaries, especially in the transfer of knowledge or technology. In the third shift (starting from 1999), the literature has emphasized the role of intermediaries in innovation systems, and the context of surveys extended to the developing world.

Borrás [57] defines different institutions and their functions in NIS. He explains the knowledge generation role of the education system (including research institutions, testing laboratories, research funding programs). He emphasizes that intermediary organizations such as technology parks, innovation networks, professional associations, knowledge brokers, incubators, entrepreneurship promotion centers, and Non-Governmental Organizations (NGOs) have a critical role in an NIS. They support knowledge diffusion, actor's orchestration, innovation guidance, knowledge devotion, technological variety reduction, risk reduction, and knowledge application supervision in an innovation system.

4.2. Intermediaries and Technology Transfer

The first studies on the role of intermediaries in the innovation system were in technology transfer [51]. Hägerstrand [58] and Rogers [59] discussed the importance of intermediaries in the diffusion and adaptation of knowledge and technology. In the past two decades, studies have defined different functions for intermediaries in the technology transfer process. Crawford [60] suggests that intermediaries can develop product prototypes to facilitate technology transfer from university to industry. Bessant and Rush [61] indicate that intermediaries such as Technology Brokers, University (Liaison Departments), Regional Technology Centers, Innovation Agencies, and Cross-national Networks (Technology Transfer Associations) can support firms in technology identification, development of skills and human resources, financial support, strategy development and implementation in business and innovation as well as providing knowledge about new technology (via education, and building knowledge transfer linkages). The other roles of intermediaries are management of the intellectual property and consultancy [62], technology assessment and evaluation [51], contract negotiation, and licensing arrangements [63].

4.3. Intermediary Services and Absorptive Capacity

A firm's capability to transfer a technology successfully lies in the set of capabilities to *"absorb and assimilate the new inputs of technology"* [61]. Capacity development is an internal and incremental process that happens via learning by doing. Cohen and Levinthal [29] mention that ACAP is *"[…] the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge"*. They believe that *"At the most elemental level, this prior knowledge includes basic skills or even a shared language but may also include knowledge of the most recent scientific or technological developments in a given field."* Nonetheless, the lack of financial and human recourses makes it difficult for smaller companies to conduct various experiences to obtain intricate technical knowledge [64, 48]. Therefore, external support can be crucial. In this regard, knowledge brokers as the facilitators of knowledge transfer assist firms in conducting the transfer process more manageably. On these bases, firms can run more transfer activities and experience and learn more from them; therefore, they develop their absorptive capacities [65].

Intermediaries enable technology absorption in a firm in two ways. First, they offer essential services when the firm lacks internal capabilities to absorb technology. These services are mainly training or education, and they directly focus on capacity building [61]. Second, intermediaries provide facilitation services to promote capacity development in the firm. These services are knowledge absorption consultancy (e.g., knowledge coding), business development consultancy (enabling the company to utilize the knowledge in its business), and they indirectly affect the capacity development process. These types of services can support capacity building by providing the firm with a chance to understand technical knowledge and therefore conduct more knowledge or technology transfer activities, as these activities can lead to internal capacity development to absorb knowledge or technology [66, 67]. For instance, analyzing technology gaps and sources (as a part of the transfer process) can assist a firm in learning more about external sources of new technology. Therefore, it can contribute to the development of a firm's capacity to recognize and acquire special knowledge or technology. Bessant [61] mentions the role of consultant intermediaries in supporting SMEs through their transfer process and developing managerial capabilities in technology transfer and absorption. Preissler [68] presents different functions (e.g., providing access to expert knowledge or resources and executive qualification) that intermediaries can have in building capacities in German firms.

To understand the functions of intermediaries' function and their role in ACAP development, we categorized intermediary

services mentioned in the literature into four categories, each impacting a dimension of ACAP. The services that lead to a better understanding of opportunities for technology transfer (e.g., networking, access to information about technology trends) or to measure the value of new technologies for the firm (e.g., technology evaluation) can impact the capacity of the firm to acquire technology (first dimension of ACAP). Training and consultancy services related to contract negotiation for technology patenting or licensing or formalizing informal transfer collaborations and brokering services are the most common services that intermediaries offer. These services can lead to the development of assimilation capacities in firms (second dimension of ACAP). The capacity building services related to knowledge management (e.g., codifying tacit knowledge), as well as consultancy and training on innovation management (e.g., developing a market-oriented product, service, or process from absorbed technology), can impact firms' capacity to transform assimilated technology into an innovative offer (third dimension of ACAP). Finally, the services that support companies in developing a new product or prototype (e.g., access to labs, consultancy of new product design) and selecting appropriate suppliers for the new product, process, or service can impact the capacity of the firms in the exploitation of the absorbed technology (fourth dimension of ACAP). Various intermediaries offer these services. The table below summarizes the literature on intermediaries' functions and links them with the respective dimension of the ACAP.

Table 1. The function of Intermediaries in the Development of ACAP Dimensions in an Innovation System

ACAP Dimension	Intermediary Function	Organization Type
Acquisition	Technology evaluation [52] Training [61] Networking (Events, Platforms) [69] Access to technological information in one area that is potentially valuable [70] Facilitating a recipient's measurement of the intangible value of knowledge received [71]	Consultancy firms (in technology assessment) Technology brokers Universities Technology transfer centers
Assimilation	Support in contract negotiation for patenting or licensing [72] Brokering (finding the right partner) [69, 72] Helping to formalize informal collaborations in terms of contractual and licensing arrangements [63]	Consultancy firms (in Patent management) Technology transfer centers Universities (liaison offices or technology parks)
Transformation	Codifying tacit knowledge [63] Knowledge Management Trainings Support in adapting specialized solutions on the market to the needs of individual user firms [73] Capacity building in Innovation Management [68]	Training Organizations Consultancy firms (in innovation and knowledge management) Universities (providing training and degree program in innovation management)
Exploitation	Selecting suppliers to make components for the technology [72] Providing access to Laboratories [68] Capacity building in Innovation Management [68] Prototyping [70] Supports in the development of new products [74]	Universities (technology parks) and research centers Product design firms NDP service providers

5. Conclusion

Recently scholars have addressed the importance of intermediaries in the development of such capacity. Nevertheless, there is no comprehensive model that defines intermediaries' function in enhancing ACAP development in a firm. In this paper, we try to fill this gap by categorizing intermediary services in technology absorption in each dimension of ACAP. Further research is needed to examine this categorization and develop a tool that can analyze intermediaries' contributions to the development of the absorptive capacity of firms. Besides, future studies should design a comprehensive model to explain how intermediaries assist the development of ACAP in a regional, sector, and national innovation system.

This paper also contributes to the development of a practical evaluation framework for policymakers and intermediaries in innovation systems. The regional and national policymakers can apply this framework as a benchmark tool to analyze the existing intermediary services with the services required to boost the absorptive capacity of the firms. Later they could design a promotion strategy to encourage existing intermediaries to modify their service portfolio or to encourage the establishment of new intermediary organizations that can offer services in line with ACAP development. Besides, intermediary organizations can use this framework as a self-assessment tool to design a new service portfolio for their organizations.

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