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## Building systems of innovation in less developed countries: the role of intermediate organizations supporting interactions in Tanzania and El Salvador

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The aim of this article is to discuss the role of intermediate organizations in supporting different forms of interactive learning and capability building in small-scale business initiatives in emerging innovation systems in developing countries, using data from Tanzania and El Salvador. It is argued that different types of intermediate organizations have played key roles in linking marginalized economic actors to sources of knowledge and other resources that are essential for capability upgrading and innovation in both traditional and more differentiated economic activities. They thus play an important role in linking innovative activity, to maintaining and upgrading the quality of existing jobs in crisis, generating new ones where opportunities arise, and providing income crucial for family well-being in countries characterized by low levels of human development and high levels of inequality.

**Keywords:** intermediate organizations; innovation systems; developing countries; Tanzania; El Salvador

### Introduction

While an increasing number of the world economies are catching up and witnessing rapid technological development, most African and Central American countries lag far behind with regards to the accumulation of technological capabilities, catching up and upgrading (Muchie et al., 2003; Lall and Pietrobelli, 2002). How these lagging economies could upgrade is a matter of concern for academics and policy-makers, including international organizations.

Innovation, understood in a broad sense, as embracing upgrading and capability building (Lundvall et al., 2009) is a crucial ‘ingredient’ for development, especially in the less developed countries (Lundvall et al., 2006; Lundvall, 1992; Muchie et al., 2003; Intarakumnerd and Chaminade, 2007; Cummings, 2007; Lall and Pietrobelli, 2005; Schmitz, 2006; Von Hippel, 1988). Scholars in the innovation system tradition highlight that innovation is the result of interactive learning taking place between organizations located in the context of specific national, regional or sectoral institutional systems (Edquist and Hommen, 2008; Balaguer, 2008; Lim, 2008; Ernst, 2007; Lundvall et al., 2006; Orozco, 2005).

The learning capabilities of a system are linked to elements of its social capital (Woolcock, 1998) and are likely to be higher in systems in which citizens regularly cooperate and engage in interactions with each other, that is, where citizens and organizations are part of stable networks

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characterized by mutual trust. In systems where this is absent, or under-developed, this poses a severe threat to competitiveness and growth (Lundvall and Borrás, 1999). Thus building linkages between different types of public and private actors involved in economic activities, and others, and encouraging interactive learning between them in order to upgrade their technological and business capabilities and innovate, is essential for the performance of national, sectoral and territorial innovation systems and ultimately for catching up and sustainable development.

The nature of innovation systems in developing countries differs substantially from those in developed countries (e.g., Arocena and Sutz, 2000; Cassiolato et al., 2003; Lundvall et al., 2009; Altenburg, 2009). Typically less developed countries are characterized by deficient socio-economic infrastructure, weaker institutional frameworks and low levels of interaction. Formal institutional, legal and regulatory frameworks are generally weakly developed and usually have less reliable enforcement mechanisms. The composition of sectors tends to be different, less diversified, with simple consumer goods (in food and clothing) being central in local manufacturing (Tybout, 2000), with a high degree of dependence on imported manufactured goods. Low levels of interaction among firms, as well as among different types of organizations (e.g., firms, universities, technology service providers) are typical of innovation systems in developing countries. Innovative firms are often isolated and suffer from few upstream and downstream linkages in the value chain, as well as specific technology institutions in their field of expertise (Arocena and Sutz, 2001). Informality in business networks, dominated by micro-enterprises and small scale agricultural production is another key distinctive feature of the innovation systems in less developed countries (e.g., Bertelsen and Müller 2003), which is often linked to higher degrees of poverty (Altenburg, 2009).

Innovation system scholars agree on the importance of understanding systems of innovation in developing countries as systems in construction (Lundvall et al., 2009; Muchie et al., 2003; Chaminade and Vang, 2008b; Cummings, 2007), where most of the organizations are there, but where the critical linkages and the institutional set-ups that are needed to facilitate innovation, are still weak and fragmented. However, the literature hitherto has been rather vague on how precisely some of the interactions in the system can be facilitated.

The aim of this paper is to discuss the role of intermediate organizations in supporting different forms of interactive learning and capability building in emerging innovation systems in Tanzania and El Salvador. It is argued that different types of intermediate organizations have played key roles in linking marginalized economic actors to knowledge sources that are essential for capability upgrading and innovation in both traditional and more differentiated economic activities. They, thus, play an important role in building up the critical linkages that facilitate innovation, supporting the emergence of systems of innovation in less developed countries. Both Tanzania and El Salvador are considered less developed countries, characterized by weak and fragmented innovation systems. Tanzania is classified as a least developed country. The national economy is primarily based on the agricultural sector. Tanzanian agriculture constitutes subsistence farming, with mainly smallholders cultivating up to 85 percent of the arable land. The majority of Tanzanians are currently either without education or only with primary school education. Most of them work as peasants or apprentices in small family enterprises. In general, even the more advanced firms do not have their own R&D departments, and only weak linkages with government R&D organizations and universities (Diyamett, 2005; Wangwe et al., 2003). Indigenous SMEs are struggling with a lack of awareness regarding relevant sources for new and appropriate technology and with limited internal capacities to implement innovations (Mahemba and De Bruijn, 2003). The national innovation system is characterized by its fragmented structure and only sporadic links among the different organizations (Mwamila and Diyamett, 2006). Intermediate organizations play here an extremely crucial task in linking relevant actors in the national innovation system to each other, and with international sources of knowledge and resources, as well as facilitating learning processes that could lead to greater innovation.

El Salvador is a small developing country ranked 90th in terms of human development out of 169 countries with comparable data. However, when adjusted for high levels of inequality (Gini, 46.9), the HDI in 2010 is lowered from 0.659 to 0.477. El Salvador is a country with the lowest level of economic growth in Latin America (3.2 percent of GDP over 60 years and 1.1 percent per capital average over last 50 years) and a human development index below the Latin American average. There are persistently high levels of poverty, labor underutilization and social deficits. The economy is characterized by a low level of social and productive investment – including R&D – needed to generate innovative capabilities, increase productivity and business competitiveness. The overall productivity and competitiveness of Salvadoran businesses is in fact declining relative to the world and thus El Salvador has an increasing commercial deficit and low capacity of insertion into global markets and to attract foreign direct investment (UNDP El Salvador, 2010). The national innovation system in El Salvador is characterized by its fragmented nature, especially in terms of sectoral specialization and territorial reach outside the metropolitan area of San Salvador, the capital city (Cummings and Mena, 2000; Cummings, 2007). On a local level, municipalities are generally not active in local economic development, rather focused on small scale, basic infrastructure investments. The state withdraw from territorial development during structural adjustment in the 1990s was especially evident in agriculture and small enterprise development. Most territorial economic development initiatives are dependent on external funding for their operations. As compared to Tanzania, most of the population is literate (81 percent in 2006); however, similarly to Tanzania, the R&D efforts of El Salvador are very low in international standards: in 2007, the R&D expenditure as a percentage of the GDP reached barely 0.1 (UNESCO, 2010).

So both countries are characterized by very fragmented and weak innovation systems and low research capabilities. Their innovation systems are basically systems in construction, where some of the components are there but where most of the linkages are absent. In this paper, we explore the role that intermediate organizations can play in supporting the interaction between different actors in the system of innovation.

The article is structured as follows. After the introduction the concepts of systems of innovation, interactive learning and intermediary organizations in less developed countries are

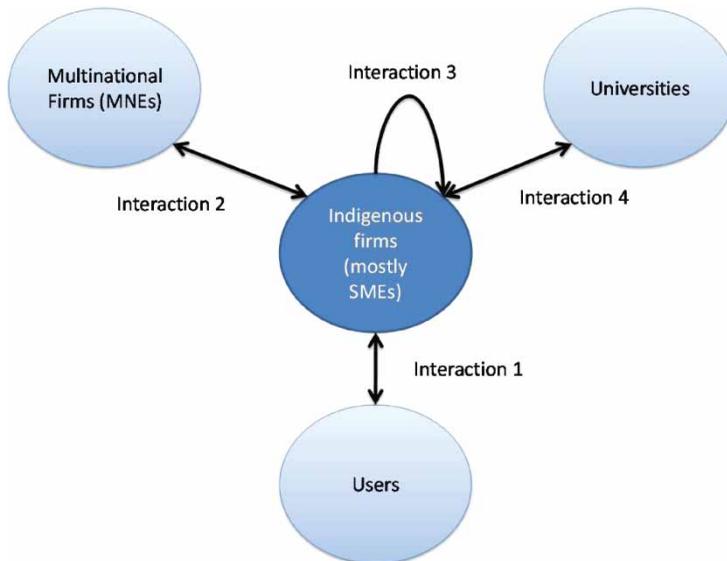


Figure 1. Basic interactions in innovation systems (in developing countries).

reviewed. This is followed by a presentation of the data and methodology, which is then analyzed in the following section. The paper ends with some conclusions on the role of intermediate organisations in linking actors, enabling technology and knowledge diffusion and building innovation systems in less developed countries.

## **Conceptual framework**

### ***Systems of innovation in developing countries***

Knowledge is considered to be the most important resource and learning the most important process in contemporary societies (Lundvall, 1992). Without interactive learning between different actors, innovations could not come about. It follows that interactions between the different actors are of utmost importance for any system of innovation. Networking capabilities are important resources and network construction a fundamental process to be fomented in building innovation systems, especially in developing country contexts. Establishing and adequately managing network connections provides not only access to exogenous knowledge but also financial and technical resources, keys for innovation. Networking capabilities, based on adequate social capital accumulation, are frequently one of the weakest elements in the South's emerging innovation systems (Cummings, 2007, 2008).

According to Lundvall (2007) and Jensen et al. (2007) innovation can encompass two specific forms of learning. These are the STI (science, technology and innovation) and the DUI (doing, using and interacting) modes of learning. The STI mode refers mostly to codified knowledge, formal learning processes and learning through experimentation. STI modes of learning almost always result from formal training, interaction with science and research organizations (like universities) and R&D. On the other hand, DUI modes of learning refer to learning at the workplace and to the transfer of tacit knowledge resulting from the interaction with users. In both cases, establishing social capital in relationships and building networking capabilities to facilitate interactive learning among the different actors is crucial. However, in many developing country contexts, the nature and gaps between the respective knowledge bases of different actors involved may be such as to require intermediary actors, to facilitate knowledge translation, distribution and assimilation.

In well functioning innovation systems both forms of interactive learning occur under a variety of agreements between firms and knowledge providers, leading to the acquisition of new knowledge and competences that can be applied to innovative practice. Broadly speaking the basic interactions in an innovation system are those taking place between (a) user–producers; (b) multinationals (MNEs)–indigenous firms, usually small and medium firms (SMEs); (c) among SMEs; and (d) between SMEs, universities and other public and private business and technical knowledge providers.

Research on innovation systems has long called attention to the importance of user–producer interactions, stressing the role that they play in innovation and upgrading processes (e.g., Lundvall, 1998; Fagerberg, 2004). The user–producer mode presupposes that the interacting users and producers are both well equipped, in terms of in-house capabilities to absorb and benefit from the knowledge and information that is shared during the collaboration.

The interactions between multinationals (MNEs) and indigenous SMEs in systems of innovation in developing countries appear especially important, taking the insufficient sources of local knowledge into account. MNEs are therefore potential providers of knowledge and technology (Dunning and Narula, 2004; Lall, 1996; Narula and Marin, 2005; Pietrobelli and Rabellotti, 2006) that may assist in upgrading (Chaminade and Vang, 2007, 2008a, b). Often, the indigenous SME are first, second or third suppliers of the MNE. In that respect, the MNEs are the users and

the relation between the indigenous SMEs (producers) and the users is here characterized by unevenness regarding how advanced the knowledge is, the amount of absorptive capacity that is available, what type of incentives that exist and who is dominating in terms of power (Pietrobelli and Rabellotti, 2009). The activities conducted by the indigenous SMEs are often in lower value-adding segments of their respective value chains, often dominated by hierarchical or quasi-hierarchical relationships between the MNEs and the dominant business governing the chains (Schmitz, 2006). Often, the MNEs have little incentive to interact with the domestic SMEs due to their lack of resources and their fear of losing sensitive knowledge (D'Costa 2006), as indicated in the literature on spillovers from MNEs to domestic firms (Dunning, 1993; Dunning and Narula, 2004). The extent to which intermediate organizations can help to translate the advanced technical knowledge from the MNE to the needs of the local indigenous firms will be investigated in this article.

Interactions among SMEs are also an essential form of interactive learning in a system of innovation. The innovation system literature argues that interactions among SMEs (and with other types of organizations) occurs best if these are co-located in the same region as they are highly dependent on tacit knowledge, in which personal ways of interacting and transferring knowledge is important (Lundvall and Borras, 1999). This applies both for developed (e.g., Asheim et al., 2003) as well as for developing countries (Giuliani, 2004; Giuliani and Bell, 2005; UNIDO, 2004; Pietrobelli and Rabellotti, 2006). However, in developing countries these interactions are often problematic as they are characterized by lack of trust, corruption in public services, regulatory enforcement and procurement procedures, and significant overlap in the production of non-differentiated products (e.g., D'Costa, 2006). Low levels of complementary specialization and limited confidence in the potential benefits of associative, complementary, collaboration among SMEs significantly restricts their collaborative potential, and results in opportunistic competitive behavior. Although many externally funded development programs promote associative business models, concrete examples of successful innovative collaboration that has resulted in significant gains in competitiveness are lacking and small business owners frequently act on a must-see-to-believe basis. This article discusses the role of intermediate organizations supporting interaction and knowledge exchange between groups of indigenous SMEs.

Finally, interactive learning processes also occur in university–industry linkages, i.e., between those who create and those who diffuse knowledge. There is extensive literature on interactions between university and industry (Mansfield, 1991, 1998; Salter and Martin, 2001), however its impact on innovation and firms innovative performance has been difficult to capture (Laursen and Salter, 2004; Fagerberg, 2004). Universities are crucial in interactions with industry, both as providers of qualified human capital, on which industry is dependent not least for building up sufficient amounts of absorptive capacity, and as sources of knowledge inputs to innovative efforts. In the South, however, university efforts are frequently skewed towards teaching, with significant rigidities in curriculum that are not necessarily in tune with business demands and entrepreneurial opportunities, and veer away from knowledge development and diffusion. This article will investigate if intermediate organizations can facilitate knowledge exchange and capability building between universities and indigenous firms (often SMEs).

Table 1 summarizes the relationship between different modes of interaction and learning, as well as the most common problems in developing countries.

Given the weakness of the linkages between the different actors in systems of innovation in most developing countries, spontaneous interactive learning dynamics are highly limited, putting further constraints on innovation and development (in addition to the lack of resources, the inadequate socio-economic infrastructure, poverty, corruption, etc). Therefore enabling different actors in the innovation system to interact with each other, and engage in interactive learning

Table 1 Different forms of interaction and developing countries

Type of interaction	What the literature says	Common problems in developing countries
User-producer	Key for DUI modes of learning	The proximity with the user is lacking, is more characterized by exploitation than cooperation, or users are not sophisticated
Multinational-indigenous SMEs	Key in developing countries but not automatic transfer of knowledge. Different forms of governance lead to different learning possibilities	Different technological capabilities of MNEs and SMEs. SMEs lack the absorptive capacity to assimilate knowledge from the MNE. SMEs in developing countries tend to be specialized in low added value activities in the value chain and linked to MNEs through hierarchical linkages.
University- Industry	Key for STI modes of learning	University research not linked to local industry needs. Lack of demand from firms or knowledge about what the university might offer.
SMEs	Social capital and cluster literature highlights that interactive learning among SMEs is crucial for innovation in clustered SMEs	No product differentiation. Exacerbated competition. Lack of trust.

processes oriented towards innovative efforts, developing networking capabilities, and learning by doing is a very important step in building innovation systems in developing countries.

While the literature on innovation systems has paid significant attention to the role paid by different forms of interaction in innovation and development, little has been said on how those interactions emerge and evolve. This is particularly true in development country contexts and between organizations with different knowledge bases and technological capabilities, and thus different levels of absorptive capacity, severe competition and lack of trust. We argue that intermediate organizations can play a significant role in reducing this gap and facilitating knowledge transfer, and the acquisition of capabilities in SME's, through supporting their interaction with different organizations in systems of innovation in developing countries.

### *Intermediate organizations*

Intermediaries play different roles in the innovation process as illustrated by the variety of terms associated with them, such as intermediary firms (Stankiewicz, 1995), bridgers (Bessant and Rush, 1995; McEvily and Zaheer, 1999), third parties (Mantel and Rosegger, 1987), brokers (Haradon and Sutton, 1997; Provan and Human, 1999), superstructure organizations (Lynn et al., 1996) or bridging institutions (Sapsed et al., 2007). Usually their main role is to address specific bottlenecks that exist in the innovation system of which they are part (Sapsed et al., 2007). Generally speaking an innovation intermediary can be defined as 'an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties' (Howells,

Table 2 Role of intermediate organizations building innovation systems

Type of interaction	The role of intermediate organizations	Illustrative case
User-producer	Translate the needs of sophisticated users to local needs	Ecological and fair trade certification of farm products in El Salvador (Case 3)
Multinational-indigenous SMEs	Translate technological knowledge from MNEs to local needs	Transfer of knowledge from Coca-cola Kwanza Ltd. Related to delivery truck emissions, to local manufacturers to be applied in improving stoves for households in Tanzania. (Case 1)
University-Industry	Facilitate the mobility of students, with short stays in firms. Student projects based on needs of local firms. Facilitate technological training by university professors in firms.	Transfer of technological knowledge from the University of Dar es Salaam to local SMEs in Tanzania (Case 2).  Support for feasibility studies and project development to support innovative SME initiatives in El Salvador. Mediation of technology transfer from international centers of technological excellence, in order to supplement weakness in national technology development to support innovative SMEs (Case 3).
SMEs	Building trust. Setting platforms for collaboration among SMEs. Identification of common problems. Collective upgrading.	TGT Gastby Clubs in Tanzania (Case 2)  Collective training to SMEs in organic production in El Salvador (case 3)

2006, p. 720). Thus, innovation intermediaries are independent third parties engaged in collaboration between different actors and supporting different steps in the innovation process.

These intermediaries can act on a for profit basis, having identified an entrepreneurial opportunity filling a gap for some specialized knowledge service activity between paying customers. However, and especially in developing country contexts, these types of actors tend to play a development role, acting on behalf of the state or with resources from the international cooperation to support small scale business enterprises to gain access to knowledge and other resources necessary to initiate and sustain innovative efforts.

A framework to analyze the role that intermediate organizations can play in innovation is offered by Hoppe and Ozdenoren (2005). Overall, their key functions are to scan and gather information and to communicate this further to those in need of the information (Lynn et al., 1996). Intermediaries thus reduce search costs and other transaction costs for different actors operating in the system. Hence, their major task is the identification, location and absorption of relevant knowledge, and to assist in its adaption to new applications, sectors or industries (Stankiewicz, 1995; Hargadon and Sutton, 1997; Hargadon, 1998).

By linking small scale businesses with other actors in the national systems of innovation, and even external sources of specialized knowledge and facilitating their engagement in interactive learning processes, intermediate organisations are performing a fundamental overall task in building innovation systems in developing countries (Szogs, 2008; Szogs et al., 2008; Cummings, 2007). Without this intermediation these different actors would have significant difficulties in collaborating, due to the physical and cognitive distances between them. Thus, by facilitating contact between different actors, these intermediaries may play a crucial role in initiating interactive

learning processes. In a developing country context, the role of intermediate organisations exceeds that of compensating for weaknesses in system functioning and could be more adequately characterized instead as building systems of innovation; creating new system linkages, constructing new networking and learning capabilities, fostering changes in the existing (formal and informal) institutional frameworks, frequently with explicit development goals related to employment and income generation, family well-being and human development.

Unquestionably, different intermediate organisations play different roles and tackle different tasks. The aim of this paper is to understand the specific role of intermediaries in supporting interactive learning between actors in innovation systems in less developed countries. The case studies in Tanzania and El Salvador provide some examples into the role that intermediaries can play facilitating interactions crucial for innovation system construction.

### Cases

The empirical material used in this paper was collected in connection with different cases in Tanzania and in El Salvador in the agro-processing industry. The agro-processing industry is an important component of the manufacturing sector in developing countries. According to the UNIDO Industrial Statistics Database, 2005, food processing in developing countries is growing as a percentage of GDP as income increases (Wilkinson and Rocha, 2008). The agro-processing industry is considered a typical example of a supplier dominated industry (Pavitt, 1984) and a resource-based industry. The upgrading in this kind of industries is often related to the development and acquisition of scientific knowledge and its application to products and processes' improvements as well as the access to information on standards for food safety and quality control (Pietrobelli and Rabellotti, 2006). Often indigenous firms in developing countries need to comply with international sanitary standards in order to enter a global value chain. The interaction with MNEs, universities or other indigenous firms may provide the indigenous firms with information on international standards as well as access to the process technology necessary to upgrade. When the technological distance between the indigenous firms and the potential source of technological knowledge is high, the interactive learning will be limited. The extent to which intermediate organizations can facilitate such transfer will be explored in this paper. Intermediate organizations considered in this paper are technological centers and non-governmental development organizations (NGDOs). NGDOs are particularly important as intermediaries in less developed countries. In general, in these countries most economic development initiatives are dependent on external funding for their operations. It is in this context NGDOs have been a driving force for trying to upgrade technological capabilities and introduce innovations in economic activities, production processes and products for national and international markets. NGDOs work to promote different types of economic initiatives in urban and rural economic sectors, with resources from international development cooperation, mobilized directly or as service providers for territorial economic development programs.

The Tanzanian material consists of interviews that were conducted during fieldwork in 2002 for the TIRDO case (Case 1) and an online survey and interviews conducted per telephone in 2007 as well as fieldwork with interviews in 2009 for the interactions between the College of Engineering and Technology (CoET) of the University of Dar es Salaam (UDSM), the NGO Tanzanian Gatsby Trust (TGT) and a group of indigenous SMEs (Case 2). For the TIRDO case (Case 1) interviews were conducted with engineers at TIRDO, as well as intermediate managers and the director general. In addition to this, both technicians, engineers and managing staff at two multinational enterprises were interviewed. For the TGT case (Case 2) the interviews were conducted with

university researchers involved in the collaboration with the indigenous SMEs, representatives of the intermediate organization, and of firms participating in the collaboration with TGT in Tanzania.

The El Salvador case (Case 3) is focused on the role of the CORDES Foundation as an intermediary organization supporting innovative efforts of different types of small scale economic initiatives involved in agricultural production, processing and marketing in dynamic national and international markets. These SMEs are integrated into the Grupo Bajo Lempa Consortium of both social and economic organizations located in the Salvadoran Municipality of Tecoluca. The case study material presented here was collected between 1993 and 2005, with follow up interviews conducted in 2011. The information was collected through several methods. During a first exploratory phase (period 1993–1997) a survey of family income and livelihood activities was carried out, interviews were conducted with key persons and available documentary data was synthesized, to characterize family livelihoods, community social and productive organisations, local development actors, their roles and specific activities. The second phase (period 1999–2001) involved specific qualitative research efforts to develop initial case studies of specific initiatives. Information was collected through semi-structured interviews with key people and available secondary sources such as internal economic data, project evaluations and other earlier studies (Cummings, 2001, 2007). Between 2002–2005 participant observation was conducted as part of work coordinated with the CORDES Bajo Lempa to elaborate a strategy to strengthen the economic initiatives and participation in different associational governance mechanisms promoting economic development in Tecoluca and its regional context; complementary interviews were carried out with key actors in the emerging regional innovation system. In 2011, complementary information was collected concerning the APRAINORES cashew nut processing initiative. An in depth interview was conducted with the manager of the cashew nut processing plant focusing on their innovative efforts over the last five years, related business performance improvements and the organizations relationship with the key intermediary organization CORDES Bajo Lempa. During this same visit it was also possible to interview university students working on a project to support APRAINORES.

Both the Tanzanian and the Salvadorian cases are used as illustrations of how intermediate organizations can play a role in stimulating the collaboration and transfer of knowledge between different actors in the system of innovation. This will be done in the next section.

## **The role of intermediaries building innovation systems in Tanzania and El Salvador**

### ***Intermediate organizations building user-producer interactions***

The regional office of the CORDES Foundation located in the Bajo Lempa region has played a crucial role in the formation and development of the initiatives that are integrated in the GBL. On a continuous basis, since its earliest work in supporting the resettlement of this area even before the civil war ended, CORDES has actively worked for building and strengthening linkages between small-scale producers as suppliers of the raw inputs (cashews, milk, fruits and vegetables) that are processed and/or commercialized. Over time CORDES also supported the legalization of the producer organizations and gradually transferred property rights to them as owners of these associational business ventures.

CORDES's capabilities as an intermediate organization has facilitated interactive learning processes between the associated producer families, the managers in charge of the different business associations as intermediate users of agricultural inputs, and the final buyers of the processed products on the national and international markets. These learning processes generated new knowledge and skills, improved networking capabilities, introduced new technological processes and in some instances created new products that are marketed nationally and

internationally. For example, in the APRAINORES (Organic and fair trade certified cashew growing and processing initiative), the development of external networking capabilities has been a causal mechanism accounting for innovation practice CORDES and the APRAINORES management have worked together over time to leverage funds from international development agencies, locally installed internationally financed development programs, and state agencies for the necessary infrastructure (especially processing plants), technical assistance, market studies and participation in international trade fairs, necessary to consolidate the technological transformations of the local producers to satisfy the demands for organic cashews in international markets. Additionally, CORDES has facilitated the relationship between APRAINORES (management, workers and producers), the national FRUTALES fruit development program, and the international experts from the Brazilian organization in charge of developing agricultural and agroindustrial technologies (EMBRAPA) to provide expert technical assistance in both organic cashew cultivation and in the industrial processing operations. CORDES, and the APRAINORES managers, played a key intermediation role between the associated producers and the international organic and fair trade certification agencies to negotiate the local application and compliance to these international certification regimes. Direct participation as exporters in the dynamic fair trade and organic cashew markets has required significant learning on the behalf of APRAINORES's management, and this process was made possible with support from CORDES commercialization program. In fact the current plant manager, in charge of marketing operations, was selected and learned alongside an international marketing expert collaborating with CORDES as his assistant.

This learning process has enabled the APRAINORES management and board of directors to assume a progressively more autonomous role in the development this associative business. An example of this is their work to mobilize financing and manage the importation of new machines (basically foot pedal operated knives) for the delicate cashew shelling operation, which have dramatically increased productivity (percentage of whole nuts), which command a significantly higher price on the international market. CORDES was not directly involved in financing or arranging the networking connections necessary for this importation process, and also not in the dynamic assimilation (Bell, 1997; Muller, 2003, 2010) of this technology into their localized production system.

Other examples of unmediated technological upgrading by APRAINORES has been to work with local technology providers to adapt the temperature and safety controls on baking ovens for certifiable use in cashew nut processing. Also, working to replace frying operations with steam based processing to condition the raw nuts at the beginning of the process before cracking, saving enough money in the first year on propane gas and other inputs to cover the \$6000 investment for local production of Brazilian cashew nut boiler technology. The fact that APRAINORES is now capable of carrying out many of the functions that were earlier mediated by CORDES is a tribute their efforts to create these capabilities, although many things have also been learned through independent learning by doing.

In sum, by linking users and producers, the intermediate organization in the GBL initiatives plays a decisive task as mediator in the construction of capabilities necessary for innovation. This intermediate organization mediates between and on behalf of producers to support their associational efforts to upgrade their agricultural production, as well as their integration as providers and eventually owners of associative agro-processing and/or commercialization enterprises. It also supports their learning to market improved products in more demanding national and international markets. The strategic emphasis on organic and fair trade certification in cases like APRAINORES, as well as associational forms of governance involving small-scale producers as owners of these operations, were actively promoted by CORDES in the different GBL SMEs.

***Intermediate organizations transferring knowledge between MNEs and local SMEs***

In a different set of interactions, namely that between MNEs and SMEs, we have investigated the role of a public R&D institute in Tanzania (TIRDO) that functioned as intermediate organization in mediating between these organizations (Szogs, 2008). TIRDO is a semi-public organization which operates since 1976 as an industrial research organization. Some of its tasks are the provision of consultancy services to industry and the support and use of local resources for the promotion of indigenous technology. Today TIRDO aims to be a center of excellence in the region with the objective to offer technological support for the creation of competitive industries. To reach this goal it conducts applied research to further develop local materials that are used in industrial processes. It further provides training facilities and runs a documentation system for dissemination of applied research information. TIRDO has good facilities (from own income generation and international agencies) and a well-structured management system to effectively run their organization and develop technologies as well as offer technical services. Facilities range from a long list of laboratory equipment to computers in the following list of divisions: food and biotechnology, agro-technology and industrial chemistry, energy and environment, materials science and technology, information technology and instrumentation, machine shop, wood workshop and library. Their current projects and development over the past years, for example in food supply chains, demonstrate that innovative practices are taken up by the organization. Our case here illustrates the role of an intermediate organization (TIRDO) facilitating the transfer of knowledge between a multinational – Coca-Cola Kwanza Ltd – and local manufacturers of indoor stoves for households.

The Coca-Cola plant in Dar es Salaam approached TIRDO in connection with the need to meet the increasing demand of activity that they were planning. The MNE intended to improve the efficiency of the loading operations and for this they needed to assure that the added emissions from truck exhaust were not too high. The study started in October 2001 and was finalized in July 2002. The intermediate organization was therefore actively involved in studying the indoor air quality with the specific task to measure emission levels and to test whether workers health and security welfare was not threatened by the new plans. The knowledge directly acquired by TIRDO through the interaction with the MNE was further used for the measurement of emission levels from indoor stoves used in households. This activity was initiated by TIRDO engineers who saw the applicability of their newly acquired knowledge on these measurements. The reason for this initiative was the known health risks with certain indoor stoves due to emission levels and importantly, before the collaboration with the MNE TIRDO did not own the necessary equipment for conducting the measurements. As part of the payment to TIRDO adequate equipment was bought.

The costs for the tests varied depending on the nature of the project. For instance: improved stoves performance testing was done by TIRDO to SMEs and NGOs that developed the improved stoves for dissemination to the households and communities. As one of the managers from TIRDO explained further:

The performance testing for single stove was about US\$ 800. If many stoves had to be tested it ranged around USD 3000 or so. In this testing it was therefore the SMEs and NGOs that borne the costs. But also when we traced further, these SMEs and NGOs were supported by either the government or international organizations that wanted such kind of information concerning ‘how much were the efficiency improved?’, which could only be answered by laboratory testing – generally, the cost of disseminating the improved stoves to the community households were borne by either the government or international donor organizations who supported TIRDO to disseminate the stoves at their specific interests. Such community projects were involving huge sums of money – above USD 10,000. (Interview with TIRDO manager, 2011)

The knowledge thus generated served as an input in the discussions with stove manufactures which eventually lead to a modification in their design (innovation). TIRDO created a bridge for

the application of MNE knowledge in one area where the MNE sought out TIRDO's capabilities (studying and reducing delivery truck emissions), to another area of identifiable business opportunity and human need (cleaner more efficient household stoves).

***Intermediate organizations facilitating interactive learning and upgrading of capabilities among indigenous SMEs***

One of the traditional roles of NGOs in least developing countries is to stimulate the collaboration and transfer of knowledge among small firms, with the final goal of upgrading their capabilities, gaining access to more dynamic national and international markets, facilitating the use of scarce resources, etc. In both our cases (Tanzania and El Salvador) we find good examples of such an intermediation role. Often, in developing countries, small firms are conglomerated in the same area or neighbourhood (as in the old guilds). They offer the same products (with almost no distinctive features) – so competition is fierce and unless there are strong family linkages (like Guanxi in China) trust is low and thus collaboration is almost inexistent.

The El Salvadoran Grupo Bajo Lemba consortium includes a group in which a small number of SMEs are co-located and interact with each other. The co-location and formal (although not legal) membership to the consortium enables interactions and reduces problems associated with trust. Also, through the interactions with the intermediate organization CORDES (as already described in the first example above) the SMEs are diversifying their products.

The introduction of new technology can support the upgrading of capabilities and the access to new markets, thus creating some differentiation with other producers. Taking as an example the BIOLACT cooperative producing and processing milk products, CORDES mobilized the necessary financing and made the necessary networking connections to import state of the art European milk processing technology, to produce gourmet type cheeses to compete with imported originals (e.g., Camenberg). These cheeses, however, proved difficult to market by an inexperienced marketing team.

Responding to this situation and the related performance problems, the now legalized BIOLACT cooperative was able to mobilize the necessary financing to purchase new equipment and begin producing traditional Salvadoran dairy products, but with international technology, and hygienic and quality control standards, to compete for public procurement in hospitals and the like. Diversification to a higher demand, although possibly less profitable market niche, has complemented the SMEs initial focus on gourmet international style cheeses, which proved more difficult to market. The fact that this second phase of innovative upgrading of their operations was self-managed in direct relation with an international development NGOs reflects capability upgrading supported by CORDES.

An interesting example of CORDES' role in supporting product diversification – specifically the organic focus to agriculture in many GBI initiatives – is their creation of BIOTEC as one of a few Central American firms producing commercial quantities of biological pesticides and plant growth stimulants. BIOTEC has now diversified its offer from an initial organic fungicide – growth stimulant (Bio-Tric) – to a new one that combats pests in sugar cane, a major commercial crop in El Salvador. This has the potential for replacing chemical pesticides which are very environmentally damaging and costly, thus providing an alternative to a process similar to the pesticide treadmill that killed cotton as well as the environment in El Salvador. The impetus for CORDES to create the BIOTEC firm (still property of the NGDO), was the development of the organic emphasis in the development strategies of the other co-localized SMEs as potential buyers for these products.

The intermediate organization CORDES has also played a key role in collectively upgrading local technical expertise, directly through financing different types of technical, productive and business development training for the GBL's economic initiatives, as well as making connections and facilitating access for key people from these initiatives to training financed by other national

and international organizations. An important advance in upgrading the endogenous knowledge base to absorb innovative knowledge has been the systematic formation of a reduced group of producers, trained to serve as ‘popular technicians’, linked to the different production ‘lines’ being promoted. For example, in the case of organic agriculture, a young local man has received specialized training and now carries a significant part of CORDES’ workload for technical assistance. He has learned about organic production, visiting Central America and Cuba, and also through training in El Salvador by experts that have put special emphasis on practical application. In 2011 he continues to support APRAINORES as a producer member of its directive council, providing expert knowledge input to business strategies, and is being paid as the coordinator for the local chapter of the Salvadoran Movement for Organic Agriculture. There is a similar case of a local man trained in the area of milk cattle production who is now part of CORDES technical staff and the BIOLACT cooperative’s directive council. CORDES has also facilitated training for key people responsible for gourmet cheese production, who have received international and national training in production and quality management techniques, and also specialized training in Cuba for the biologists working at BIOTEC.

Another effort to stimulate greater interactive learning to build up the endogenous productive knowledge base among producer SMEs was the promotion of on-farm participatory experimentation with producers. Topics have included diverse techniques for vegetative grafting to renew unproductive cashew trees and to select the genetic material to be used in renovating or replanting the cashew plantations, as well as biological pest control and the production of organic fertilizer. This process was promoted by an agricultural technician from a Dutch NGDO with a long-term commitment to provide technical support to CORDES’ agricultural program.

CORDES role in capability upgrading in this SME cluster has been diverse, ranging from direct support to training for SME, to training for local technicians who support their development over time – even when CORDES can no longer finance agricultural engineers to do so. It has also supported product diversification directly, but also indirectly through the learning by doing implied in management’s involvement in the directly supported processes, and the creation of a co-localized specialized organic input supplier.

A similar intermediation role has been played by the Tanzania Gatsby Trust (TGT), facilitating interactions among SMEs. TGT contributed directly to the development of the SME Gatsby Clubs – an idea that is similar to the GBL consortium regarding the joint location of SMEs in different regional areas. A Gatsby Club offers people interested in similar businesses the opportunity to gather together and ideally find a market together. Collaborations initiated through the membership may also lead to sharing some of the costs. Members:

... have a common showroom where they put their products for people to see and when you visit the showroom, then if you are interested in any of the products, then you get the contact of where to get more of these products. (Coordinator, external links, CoET-U DSM, 2009)

According to firms belonging to the clubs, the membership in the Gatsby Clubs provided several advantages such as: financial support from TGT, regular access to workshops and trade fairs, they further received an email address and had access to the so-called showroom in which they can present their products (Szogs, 2010). At the end of 2006 six such clubs were formed: the Nyamagana Club and Ilemela Club in Mwanza City, the Sengerema Gatsby Club in Sengerema district, which is the biggest with about 150 members. The other clubs have about 20–25 members each. There is, further, the Nzega Gatsby Club in the Tabora region with 18 entrepreneurs and finally the Sikonge Gatsby Club in Tabora and the Sikonge Gatsby Club. Another crucial action of the intermediate organization TGT was the implementation of training sessions to reduce the skill shortage

of the indigenous firms participating in the Clubs. Two main categories of these training courses were: business management and technology management.

### ***Intermediate organizations linking universities with industry***

The specific aim of the collaboration between TGT, CoET and SMEs was to expose engineering students to the issues and problems that challenge SMEs, to provide financial assistance to a selected group of such students to develop final year projects that are of relevance to the identified SMEs, to develop business plans for specific SMEs and to undertake research and development of new proto-types for SMEs (Katalambula et al., 2006). Thus, firms have been contacted by students and their supervisors as a result of findings of a survey as part of the above collaboration. CoET had already in 2002 performed a feasibility study, which was the conduction of an SME survey. This countrywide survey on the status and needs of SMEs in Tanzania was in 2004 supported by TGT. Target groups of the survey were technology based SMEs, consisting of entrepreneurs that were not trading but capable of producing goods. The aim was the identification of technology gaps and based on this to find solutions for the problems – one of the mechanisms to address them being the student projects. Hence, students and supervisors contacted selected SMEs to develop an idea; once the product or technology is developed they transferred it to the firm where it is in most cases tested and then installed. In some cases SMEs come up with proposals and then together with a university lecturer look for students. Importantly, before a project is started and funded it must have a collaborating SME needing that particular product. A total of 86 student projects has been implemented during the period 2001–2008 (UDSM, 2008). Of the final year projects with important findings in particular, two have had impressive results and therefore are mentioned specifically.

One of the results is the clarification of juice and wine using pectrinase enzymes which was adopted by M/s Solar Innovations. The other project dealt with the quality of soymilk as influenced by the blanching conditions and this was adopted by two companies – Abantu Food Products and M/s Soja Halisi Foods. Based on the outcomes of the student project the firms made a number of essential achievements and improvements, such as the reduction of the loss of flour from a milling machine from 20 percent to only two percent, improvement of the qualities of wine, soya food, solar dried fruits, developing specialized technologies and machinery for some entrepreneurs, etc. A very important aspect of the students' consultancy to the specific agricultural units in the country was also that they contributed to creating a link between the university and its research and applications in the industry, a link that is generally not well developed in the Tanzanian innovation system. Additionally, the SMEs were also introduced to expertise from the university that could assist in the development of business plans for specific SMEs and to conduct research and development of new prototypes for the SMEs (TGT and CoET, 2006).

Another important initiative by the intermediate organization in order to link the university and industry was a series of local workshops for training, and also offering a crucial platform for networking with other SMEs located in the same area (thus at the same time also an important outcome of 'intermediate organization-intervention' in SME interactions). The workshops have at a later stage developed into more advanced technology development and transfer workshops that both serve to raise awareness among the existence and capabilities of the stakeholders, as well as the identification of technical gaps that SMEs were confronted with and for which the university could assist with solutions. A positive outcome of the workshops was also to increase the interactions and the transfer of organizational and technological knowledge and experience.

In El Salvador the public and private university system as it emerged from the civil war (1979–1992) is focused on teaching, has little research capacity and have generally not been relevant actors in promoting innovation in SMEs such as those associated with the GBL consortium.

However, CORDES Bajo Lempa has been successful in contacting relevant university departments and mobilizing students to elaborate studies and proposals in different technical and administrative fields relevant for solving specific business needs. In 2011, the Central American University was also collaborating directly with APRAINORES in a project to test the potential of the highly combustible cashew nut shells, as first step in converting them into viable heat source to reduce the plant's cost of purchasing propane gas, and also reduce the problem of what to do with these shells as a hard to dispose of waste product (interview with UCA students at APRAINORES plant).

Given the weakness of endogenous technology development at universities or other technology centres in El Salvador, CORDES has instead mediated the importation of technological knowledge and embodied production technologies to support innovation in the GBL's initiatives. This is the case with EMBRAPA from Brazil supporting innovation in cashew growing and processing, as well as European technology providers and trainers to guarantee the initial operational assimilation of BIOLACTS milk processing technology. This list also includes CORDES's support for international transfer of technology for producing granulated *panela* – unrefined brown sugar – from Colombia's para-statal *panela* technology development organization (CIMPA). This last effort was largely unsuccessful given that the endogenous absorptive capacity was insufficient. There were no local skilled workers with experience and the specialized tacit knowledge developed through traditional *panela* production to support dynamic assimilation of the imported technology. This last example suggests the limitations of intermediated technology transfer if there is not a corresponding effort to build endogenous technological capabilities.

Table 2 summarises the main findings of our research on the role that intermediate organizations have played supporting different forms of interactive learning and accumulation of capabilities in Tanzania and El Salvador.

## Conclusions

Current research on innovation systems in developing countries confirms the emerging, fragmented, incomplete nature of the systems which can be viewed as still under construction, within fragile, dependent economies and societies that often suffer from high levels of socio-economic exclusion and extreme income and knowledge inequalities. Often the system linkages that could exist between the various key public and private actors in these countries' emerging national, sectoral and territorial innovation systems are weak, non-existent or in the worst case scenarios, characterized by exploitation, opportunistic competition, paternalistic and corrupting support with explicit political overtones, etc. Complementary specialization and synergy, key for the development of innovation capabilities, are rare qualities to be found.

This lack of continuous interactions, complementary specialization and synergy emerging from interaction, reduces the possibilities for important interactive learning processes leading to capability upgrading and innovation. As analyzed in the key types of interactions existing in systems of innovation, intermediate organizations perform key tasks that have proven important in linking actors to each other, strengthening interactive learning and networking capabilities, and thus contributing to establishing the well functioning system linkages between capable actors that are the building blocks of the innovation system as a whole. On a more micro level, important learning processes with outcomes in terms of increased knowledge, improved production processes; diversified products for new markets, etc, were also revealed.

Linking the concluding discussion back to the theoretical synthesis on the different interactions in innovation systems, the literature on user–producer modes assumes that the interacting users and producers are engaging frequently and on the basis of equal preconditions in terms of

resources such as in-house human capital, equipment, etc. The analysis of our case study material showed that the linkages with users in developing countries are not straightforward. Local users are not sophisticated, and thus do not provide the incentive to innovate, while most SMEs do not have direct contact to the most dynamic national and international users—consumers. The intermediate organizations have played a crucial task in linking users—consumers and producers to each other. Their main role is to transfer information from the users to the producers (for example, the demand for organic products and the corresponding requirements for certification) and help them meeting that demand. Improved skills, networking capabilities and even product innovation are the result of learning by interacting between small-scale local business enterprises and other supporting and exogenous actors.

As the literature on MNEs—SMEs has argued that these interactions are potentially important for the local SMEs, as the MNEs represent a crucial link to global flows of knowledge and generally more advanced technology. However, often the incentives of the MNE to support upgrading in the indigenous SMEs are limited, due to the low level of resources, absorptive capacity, networking capability etc of the local SMEs. As the experience of TIRDO (Case 1) has shown, intermediate organizations can play an extremely crucial role as mediators in these interactions, so as to materialize the real potential benefits that MNEs represent for the domestic industry. They form thus a particular mechanism for strengthening these interactions, so as to create win—win situations, enabling mutually reinforcing interactions and innovative synergy. In our cases the intermediate organization played a role facilitating knowledge transfer and assimilation, but they also supported the accumulation of capabilities, that could be applied to future innovative effort.

In the case of interaction among SMEs the main role of the intermediate organizations was to enable and support linkages among SMEs. This demonstrated the crucial capabilities, enabling the exchange of critical knowledge and complementary resources necessary for technological innovations to come about. Also the intermediate organization initiated and offered platforms through which networking relationships could be established and developed, based on social capital accumulation. Finally, the case study analysis illustrates the role of the intermediate organizations facilitating the diversification of the local economic activities, which has the potential to enhance the collaboration of formerly competing firms, through complementary specialization.

In this paper, we have highlighted the potentiality of several different types of intermediary organizations to contribute to building systems of innovation in developing countries and we have illustrated this with several examples from Tanzania and El Salvador. The cases explicitly recognize the capabilities of different types of public and private intermediary organizations in establishing and developing system linkages in two particular less developed countries: Tanzania and El Salvador. However, the effective impact that such intermediation might have on learning, and especially innovation towards business competitiveness, in local and internationalized value chains, and now in terms of resilience to crisis, is still to be further researched. Issues such as the sustainability of intermediate organization interventions with SMEs, or the capabilities of these organizations to capture and facilitate the dynamic local assimilation of exogenous knowledge and resources, in a way that builds off existing knowledge and capabilities, potential complementarities between NGOs and State agencies in areas such as value chain upgrading, export promotion and SME—MNE linkages remain to be explored in terms of their impact on learning and accumulation of technological capabilities. More research is needed on the determinants of the impact of such intermediation, by different types of such organizations, on learning and especially its translation into innovation and business competitiveness.

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