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Building absorptive capacity in less developed countries The case of Tanzania

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Abstract

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It is therefore crucial to understand how this capacity can be build so that the indigenous firms can benefit from external knowledge sources. Drawing on case study material, this paper investigates the role of intermediate organizations in facilitating technological knowledge transfer between the university and the indigenous SMEs, discussing how capabilities are built during such intermediation. Particularly, we discuss the role of NGOs facilitating the transfer of knowledge between universities and SMEs in Tanzania and the accumulation of new technological capabilities (absorptive capacity) in the latter.

Keywords: Systems of innovation, absorptive capacity, Tanzania, innovation, NGOs.

Building absorptive capacity in less developed countries
The case of Tanzania

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Abstract:

African countries lag clearly behind developed countries when it comes to accumulating technological capabilities, upgrading and catching up. Also, firms in least developed countries are characterised by very low levels of absorptive capacity. It is therefore crucial to understand how this capacity can be build so that the indigenous firms can benefit from external knowledge sources. Drawing on case study material, this paper investigates the role of intermediate organizations in facilitating technological knowledge transfer between the university and the indigenous SMEs, discussing how capabilities are built during such intermediation. Particularly, we discuss the role of NGOs facilitating the transfer of knowledge between universities and SMEs in Tanzania and the accumulation of new technological capabilities (absorptive capacity) in the latter.

1. Introduction

Innovation, understood as upgrading and capability building is considered a fundamental engine of transformation and growth, particularly in less developed countries (Intarakumnerd and Chaminade, 2008; Lall and Pietrobelli, 2005; Lundvall et al. 2006). As the successful experience of some Asian countries has demonstrated, innovation and growth is highly dependant on the accumulation (and use) of human and organizational capabilities (Bell, 2002, Castellacci and Archibugi, forthcoming) within a certain national, sectoral or regional system of innovation (Edquist and Hommen, 2008; Balaguer, 2008, Lim, 2008, Wong & Singh, 2008, Ernst, 2007, Chaminade and Vang, forthcoming; Lundvall et al, 2006). But while large part of the world experiences un-precedent technological development, African countries lag clearly behind when it comes to accumulating technological capabilities, upgrading and catching up (Muchie et al 2003; Lall and Pietrobelli, 2002)[1].

Capabilities result out of interactions and linkages between a number of actors, such as firms (through collaborations both with complementary and competing ones) as well as universities and research centres (Kline and Rosenberg, 1986; Bell and Pavitt, 1993). In developing countries, two specific forms of interactions appear especially critical as sources of technological knowledge supporting upgrading in indigenous firms, particularly SMEs. These are, on the one hand, the interactions with MNCs

[1] Many African countries are considered as Less Developed Countries characterized by low levels of per capita income, human resource development and high degree of economic vulnerability. Half of the population is under the threshold of poverty, 40% suffers from malnutrition and hunger and 1 out of 4 Africans suffer from HIV/AIDS (Hassan, 2003). A large proportion of the population is excluded from the formal economy and thus is not reflected in any official statistics.

(e.g. Durham, 2004, Dunning, 1993, Narula & Dunning, 2000, Cantwell, 1995) in order to absorb potential spillovers resulting from FDI and, on the other hand, the interactions with University (Lundvall, 2008, Gunasekara, 2006; Krishna, 2001, Basant and Chandra, 2006). But as recent research has shown (Dantas et al, 2008; Bell and Marin, 2004), attracting FDI (interactions with MNCs) or promoting university-industry linkages might not lead to the effective transfer of knowledge unless the receptive firm (in this case the indigenous firm) has built enough absorptive capacity. It is the firm's level of absorptive capacity that shapes the extent to which firms can benefit from technological knowledge available in global and local networks (Bell and Giuliani, 2007; Giuliani and Bell, 2005). As firms in least developed countries are characterised by very low levels of absorptive capacity (Dantas et al, 2008; Lall, 1992, Narula, 2004) it becomes crucial to understand how this capacity can be build so that the indigenous firms can benefit from external knowledge sources.

With few exceptions (Dutrenit, 2000) the literature has paid little attention to *how* firms in developing countries can build up absorptive capacity. As the literature on industrial districts in Italy has shown, (Gambarotto and Solari, 2005) intermediate organizations may play a fundamental role facilitating knowledge transfer between organizations with different levels of technological capabilities (and thus absorptive capacity). Intermediate organizations can "translate" the knowledge generated by the most advanced organization (for example a MNC) to the specific needs and technological level of the receptor organization (for example, an SME). While this literature is rich in providing information about the characteristics of these intermediate organizations (Howells, 2006; Sapsed et al. 2007) or their role in science,

technology and innovation policy (Asheim et al 2003), the literature is far more limited when it comes to *how* this intermediation might support capability building in certain organizations.

This paper investigates the role of intermediate organizations in facilitating technological knowledge transfer between the university and the indigenous SMEs, discussing how capabilities are built during such intermediation. Particularly, we discuss the role of NGOs facilitating the transfer of knowledge between universities and SMEs in Tanzania and the accumulation of new technological capabilities (absorptive capacity) in the latter. Tanzania is one of the poorest countries in the world. Its economy is fundamentally based on agriculture, with an emerging industrial base. Tanzania's informal sector employs about 2 million people, which is a twice bigger number than that of the formal sector. Tanzania's innovation system is often described as islands of socio-economic, science and technology institutions with very low capabilities and hardly any linkages (Diyamett & Wangwe, 2006). In this context, the University of Dar Es Salaam is one of the most important sources of technical knowledge in the country. However, its linkages with the local industry are extremely weak (Szogs, 2008). The case illustrates how an NGO, the Tanzania Gatsby Trust (TGT), facilitated the transfer of knowledge between the University of Dar Es Salaam and how this contributed to improve the absorptive capacity of a group of indigenous SMEs.

The paper is based on an online survey and semi-structured interviews conducted in July and August 2007 to University researchers, representatives of the intermediate

organization and of firms participating in the collaboration. The paper provides an analytical framework to assess capability building in collaborative projects, which is further tested for the collaboration between CoET, TGT and a group of indigenous SMEs.

The paper is structured as follows. The analytical framework is presented after the introduction. The concepts of innovation systems, absorptive capacity and intermediate organisations are briefly reviewed and the discussion embedded in the specificities of least developed countries. This is followed by a presentation and discussion of the case, covering the interaction between three sets of actors: the College of Engineering and Technology (CoET) of the University of Dar es Salaam (UDSM), the Tanzanian Gatsby Trust (TGT) and a group of indigenous SMEs. We present the results of the case study in chapter four and discuss the implications of the interactions among the three actors on the absorptive capacity building process. We round up the paper with conclusions and future research suggestions in the final chapter.

2. Innovation systems, absorptive capacity and less developed countries

2.1. Innovation systems in less developed countries

Much research within economic growth, upgrading, innovation and economic development has focused on the accumulation of competences or the creation of markets as cornerstones of the development process. The innovation system (IS) approach, on the contrary, focuses on and emphasizes that the innovation process is of systemic nature, (Lundvall, 1992; Edquist, 1997) meaning that it is the result of an interactive process between the various components of a system, i.e. of the multitude of actors as well the formal and informal institutions. In this sense, it is not the accumulation of competences what impacts on economic growth and development but how these competences are mobilized –used and shared- between the different organizations of the system. The systems vary in their strong or weak components which in its turn impact the overall efficiency of the whole system.

The IS concept that emerged in the late eighties (Freeman, 1987) and was further developed theoretically (Lundvall, 1992; Edquist, 1997) and empirically (Nelson, 1993) during the early nineties, has been widely adopted by academics, practitioners and policy makers both in the developed and in the developing world. The IS concept addresses and analyzes the interactions between public and private actors and how these may lead to the generation of innovation (Freeman, 1987; Lundvall, 1988 and 1992; Nelson, 1993; Edquist, 1997; Johnson, 1992). Scholars in the "IS tradition" argue that innovations "are rooted both in the production structure and

the institutional set-up of the economy" (Johnson, 1992: 34) and are the result of the interactive learning taking place between the different organizations of the system. Without doubt, the institutional set-up of a given country influences the way technical change can take place, but also the specificities of product and market development and firm growth.

IS in developing countries differ significantly from well functioning systems in the industrialized world in a number of ways. Firstly, the systems are part of different institutional frameworks[2] where the indigenous formal institutions are often weak. Secondly, the actors in the system are in many cases not very well linked to each other and interactions often occur in a rather sporadic way (Narula, 2002, Muchie et al, 2003,). Thirdly, in developing countries, with limited local knowledge resources, the access to foreign sources of knowledge and capital (FDI or linkages with MNCs) are crucial (Amin, 2004, Loebis and Schmitz, 2005; Pietrobelli and Rabellotti, 2006; Schmitz 2006; Vang and Asheim, 2006). Fourthly, as in any IS, universities in developing countries are one of the critical sources of knowledge, but they tend to be specialized in the provision of qualified human capital, their research capacity is often limited and their linkages with the indigenous industry almost inexistent (e.g. Mwamila & Diyamett, 2006). Finally, the purpose of the IS as a whole seems to be different as well. While in most developed countries the focus is on the creation of new knowledge and innovations that are at the forefront, in many developing

[2] A "national institutional framework" refers to "the set of rules and understanding which govern the systems of labor market regulation, of education and training, of corporate governance and of product market regulation, in which companies or their subsidiaries located in a particular economy are embedded" (Soskice, 1996: 16). Importantly, "these frameworks both constrain and offer opportunities to companies" (ibid).

countries, the focus is on the acquisition and adoption of knowledge developed elsewhere (e.g. Lall, 1992, Muchie et al. 2003).

Facilitating the access to external sources of knowledge is a necessary but not sufficient condition for upgrading and innovating. Unless there is a sufficient level of absorptive capacity in the indigenous firms, the ability of firms to identify, acquire and develop external knowledge is very limited (Cohen and Levinthal, 1990; Lall, 1992). Due to the very low level of absorptive capacity in the indigenous firms, intermediate organizations may play a crucial role as mediators between the foreign and local sources of knowledge and assist in the process of transferring knowledge and assimilating and adapting it to the wider local context (Szogs, 2008).

2.2. Absorptive capacity

Absorptive capacity is generally defined as the ability of the firm to utilise available information and knowledge that comes through the interaction with other organisations, such as other firms, users or knowledge providers (i.e. research institutions) (Cohen and Levinthal, 1990; Giuliani and Bell, 2005). It involves the ability to recognise the value of the information and knowledge deemed necessary for the firm's innovation process, to be able to acquire it, assimilate it, transform it and exploit it (Todorova and Durisin, 2007). Thus, absorptive capacity increases a

firm `s access as well as usage (processing and commercializing) of knowledge and information through collaboration with other actors. The absorptive capacity is a function of the firm's skill base, its internal technological effort and its linkages with external sources of knowledge (Lall, 1992).

In order to identify, assimilate and adapt knowledge that is needed for innovation and to engage in interactive learning, accumulating qualified human capital is crucial (Lall, 1992; Chaminade and Vang, 2008). As indigenous firms in developing countries generally have only limited access to human capital, management skills and competences, their available absorptive capacity is rather insufficient. Due to the limited available absorptive capacity other firms in the system may find little incentives to interact with these low absorptive capacity firms (Tidd et al. 2005). This, in turn, may reduce the chances of domestic firms to participate in interactive learning processes (Giuliani and Bell, 2005). Based on this, building human capital and training in specific industry needs is a cornerstone of interactive learning.

Moreover, in order to be able to identify, select and acquire the external technological knowledge that might be relevant to the firm, the firm's own technological effort is essential (Lall and Pietrobelli, 2005). With regards to technological efforts, there are important differences between developed and developing countries:

First, the intensity and nature of the technological effort is different if the purpose is to be a technological leader, i.e. to create innovations (as in developed countries) than if the purpose is to monitor and absorb technology that has been developed

elsewhere (as in developing countries). Activities such as R&D might be relevant for both, developed and developing countries, however, the nature of R&D may differ as well as the actors conducting it[3]. Even imitations can require major investments in organizations and capabilities (Metcalfe, 2000). For example, while R&D in developed countries is mainly basic research, in developing countries, "a substantial part of R&D is for monitoring and absorption rather than frontier innovation" (Lall and Pietrobelli, 2005).

Secondly, and linked to the previous point, is the importance to distinguish between product-related technological capabilities and process-related technological capabilities. Technological effort in developing countries is usually oriented towards the absorption of technologies developed elsewhere (which in turn requires process innovations), more than the development of own innovation (product innovation) (Balaguer et al, 2008, Kam Wong & Singh 2008, Lim, 2008). If the purpose is to absorb (at least in least developed countries), we can assume that process-related technological effort is more important than product related technological effort. In process related technological effort we include the (investment in) acquisition of machinery, certifications and standards, organizational innovation, etc. In product related technological effort, we include R&D, receiving technical specifications for product development or the participation in an incubation program.

[3] For instance, in Tanzania, it is rather public technology service providers, i.e. publicly owned research organizations that perform most of the R&D as compared to the domestic enterprises (see e.g. Szogs, 2008; Bongenaar 1997; 1999).

The linkages with external sources of knowledge are the third element shaping the absorptive capacity of a firm. The relationship between absorptive capacity and the access to knowledge networks is bi-directional. On the one hand, networks have a significant impact on the firms absorptive capacity as the literature on networks has largely acknowledged (Dantas et al. 2008). The network ties in which a firm is embedded influence its absorptive capacity through e.g. interactive learning with actors in the network. On the other hand, the heterogeneity in the firms' initial endowment of competences and capabilities also shapes the dynamics of the networks in which they are participating (Giuliani and Bell, 2005; Bell and Giuliani, 2007)

Put differently this means that the way a firm is connected to other firms and actors in the network has an impact on how a firms absorptive capacity contributes to product innovation. And, complementary, the absorptive capacity of the firm will in its turn influence the way in which the social network ties contribute to the innovation output of the firm (e.g. Yao & McEvily, 2000).

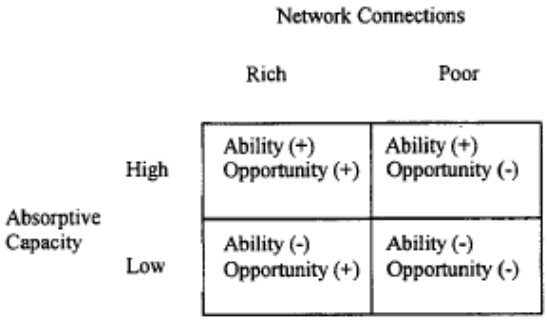

Figure 1: The contingent effect of absorptive capacity and social network. Source: Yao & McEvily, 2000: 710.

While most literature acknowledges that facilitating the access to external sources of knowledge in developing countries have limited or no effect at all on development and economic growth without prior absorptive capacity building (e.g. Durham, 2004; Narula, 2004), the literature is limited when it comes to analyzing *how* the absorptive capacity can be built. This becomes especially crucial for developing countries where, as indicated earlier, the IS is generally weak[4]. Due to the weaknesses in the institutional and organisational framework, indigenous firms face the challenge of building a sufficient level of absorptive capacity to benefit from potential knowledge spillovers.

In a Tanzanian context, previous research has shown that intermediate organizations, who might perform R&D themselves and might have a better level of absorptive capacity than the local industry, can function as crucial mediators between foreign and local sources of knowledge, i.e. can act as transferors of knowledge between different actors in the system (Szogs, 2008). These mediator or intermediate organisations may be highly important in a least developed country context in order to a) be able to facilitate knowledge transfer from foreign sources, b) assimilate it to the local context and 3) contribute to building absorptive capacity in indigenous firms.

[4] As characterized by weak technological infrastructure, weak institutional framework and only limited interactions and linkages between the actors in the system, which reduces the positive effect a network could have on the firms absorptive capacity building process.

2.3. Intermediate organizations

Intermediate organizations, often also called "intermediaries", is the term used to refer to organizations that play a bridging role in the innovation system. The role that intermediate organisations play in the innovation process has been described with different terms in the literature, such as: intermediary firms (Stankiewicz, 1995), bridgers (Bessant & Rush, 1995; McEvily & Zaheer, 1999), third parties (Mantel & Rosegger, 1987), brokers (Hargadon & Sutton, 1997) Provan & Human, 1999), superstructure organizations (Lynn, et al. 1996) or bridging institutions (Sapsed et al 2007).

The overall role of these intermediate organizations is to compensate in different ways for weaknesses in the innovation system (Sapsed et al. 2007), facilitating the dialogue and knowledge transfer between different organizations of the system that otherwise will not collaborate. The role of the intermediaries has been addressed in different research fields, ranging from literature on technology transfer and diffusion to innovation management, systems of innovation literature and knowledge intensive business services firms (see Howells 2006) each putting emphasis on different aspects of their role. As Howells study shows, the role of intermediate organisations in the innovation process can be further unpacked into different functions, relationships and processes.

Two main functions appear to be a) the information scanning and information gathering function and b) the communication function (Lynn et al, 1996 & Wolpert 2002). That is, intermediate organizations' main roles are to identify, locate and

absorb knowledge that is relevant for the innovation system, to adapt it to new applications even in other sectors or industries and to transfer it to new users (Stankiewicz, 1995; Hargadon & Sutton, 1997; Hargadon, 1998).

Through its extensive review of the literature on intermediation and the role of intermediaries in innovation, Howells finds that a more specified account of the functions and different roles that they perform over time and their impact in different national and local systems still needs to be researched (Howells, 2006). He also suggests that the types and nature of relationships in which intermediates exist also needs to be further researched.

Addressing this issue is imperative when analysing innovation in least developed countries. As the absorptive capacity in these countries is very low, understanding how intermediate organizations might support the transfer of knowledge and capacity building among indigenous firms is essential. The following sections describe how this has been done in Tanzania.

3. The case

3.1. Tanzania

Tanzania is one of the poorest countries in the world, with an annual per capital income of US 350 in 2005. Half of the population is below the poverty line (WB, 2007). Agriculture contributes to 50% of the GDP and the service sector responds to

approximately 40% (Mwamila & Diyamett, 2006). Tanzanian industry is "at an embryonic state of development" (Ministry of Industries and Trade, 1996) and lacks any significant linkages with the other sectors as well as the knowledge providers. The Tanzanian innovation system can be described as made of organizations with very low capabilities and hardly any linkages (Diyamett & Wangwe, 2006). In terms of capabilities, scientists and engineers in Tanzania make up a very little percentage of the population. In 1999, there were only 5548 scientists and 2207 engineers which make up less than 1% of the total population. There are 62 R&D institutes in the country, including 3 universities as the major producers of scientists and engineers. The industrial R&D is held by the Tanzania Industrial Research Development Organization (TIRDO), the Centre for Agricultural Mechanization and Rural Technology (CARMATEC) and the Tanzania Engineering and Manufacturing Design Organization (TEMDO). These organizations as well do not receive governmental support and therefore have transformed into more consultancy providing agencies with very limited linkages and impacts on the local firms (Lall and Pietrobelli, 2005).

As one of the most important sources of qualified human capital, the University of Dar Es Salaam has an important potential role in the emerging Tanzanian innovation system (Mwamila and Diyamett, 2006). However, with limited exceptions, the link between the University and the private sector is considered to be generally weak.

3.2. The Tanzania Gatsby Trust (TGT) - College of Engineering and Technology (CoET) and SMEs collaboration

Our case is based on the analysis of the interaction between three sets of actors in the Tanzanian innovation system: the College of Engineering and Technology (CoET) of the University of Dar Es Salaam (UDSM), the Tanzania Gatsby Trust (TGT) and a group of indigenous SMEs.

Information was collected through a survey followed up by in-depth interview. The survey was sent to 350 email addresses registered at UDSM. Out of these 40 employees responded. 10 of these were selected for in-depth follow up through a series of telephone semi-structured interviews in July and August 2007.

The University of Dar Es Salaam is the largest and oldest of the 10 big universities in Tanzania. It educates more than 70% of all the university students in the country which is approximately 15,000 people (Mwamila and Diyamett, 2006). The College of Engineering and Technology (CoET) has been formed through integration of the Faculty of Engineering (FoE) and the Institute of Production Innovation (IPI) at UDSM. CoET's objective has been to become the leading institution in engineering and technology at national and regional levels (Mwamila, 2001). UDSM is trying to establish linkages with all the possible actors of the NSI and incorporate them into its research agenda since it is expected to give better results and financial opportunities. Still, most of such established linkages are not registered and many employees work mostly within their personal interactions with entrepreneurs and other

organizations. Such linkages can be called passive linkages since they are not established directly with the faculties as intended, but still there is an information flow among the university units through its members and the outside actors.

Tanzania Gatsby Trust (TGT) NGO has been formed in 1992 in the sequence of African Gatsby Trusts establishments based on the funding and prototype of the Gatsby Charitable Foundation of United Kingdom. TGT is supporting SMEs and micro-finance in Tanzania. Gatsby Trusts' activities involve neighboring Kenya, Uganda, and Cameroon. Each Gatsby Club in Africa has focused and specialized on different aspects of development, more relevant to the local conditions, but as a result of cooperation, meetings and information exchange successful projects have been applied in other Gatsby member countries. The well-established relationship among the Gatsby Trusts is the source of innovations within these organizations and the projects implemented in the respective countries. For example improvements in agricultural production were first implemented in Cameroon, and then undertaken similarly in Tanzania.

The University- Gatsby Trust-SMEs interaction, that is the focus of this paper, originated in Uganda and proved to be successful; it was later used in Tanzania and is pending in Kenya.

The cooperation between TGT and the CoET (by then still FoE and IPI), started in January 2001 with the agreement to collaborate in the area of Technology

Development and Transfer in order to help the Small and Medium-Scale Enterprises (SMEs) in Tanzania[5].

The objectives of the CoET - TGT collaboration were "i) to further expose the engineering students to the issues and problems that SMEs were facing; ii) to provide assistance to a selected group of undergraduate students who were encouraged to develop their final year projects in issues relevant to the identified SMEs; iii) to facilitate the development of business plans for specific SMEs using expertise available at the University; and iv) to carry out research and development of new prototypes for SMEs' (TGT & CoET, 2006).

To attain these objectives, a number of strategies were proposed: a survey of the nature and scope of operations, employment characteristics and income generation of targeted SME sectors; assignments of students to specific SMEs or associations of SMEs in the course of their studies; development of practical and innovative prototype projects which will be further developed in collaboration either with an individual SME or a cluster of SMEs working in the same sector; linking CoET staff to specific SMEs or clusters of SMEs, in order to assist in the development of their business plans and the identification of specific bottlenecks in the development of a sub sector, which can be addressed through targeted Research and Development (R&D)" (ibid).

[5] The Memorandum of Understanding was signed between CoET and TGT in 2002 which was an agreement assuring easy access by Small and Medium Scale Enterprises to appropriate technologies developed or brokered by CoET through its Technology Development and Transfer Centre (TDTC).

The collaboration started to act with a pilot phase in 2001-2003; the food processing sector, the Tanzania Food Processing Association (TAFOPA) and other relevant sectoral associations agreed to take part in this phase. The next step was to deepen the activities developed in the food processing sector and to incorporate all other SME sectors. The third phase was the support of technology incubator units and SME clubs.

At the end of 2007, a number of activities had been successfully implemented:

1. Student projects that have relevance to SMEs
2. Technology Development and Transfer Workshops
3. Country-wide SME survey
4. SME Stakeholders Workshops in four zones
5. Establishment of a national technology-based SME Incubator Program
6. Feasibility study on shelter/housing in Zanzibar, Rukwa, and Mtwara regions.
7. Establishment of SME (Gatsby) Clubs (ibid).

Next we will illustrate how these different activities contributed to the development of the skill base, the technological effort and the networks of the SMEs participating in the project.

4. Results. Building absorptive capacity in SMEs in Tanzania.

4.1. Building up the skill base

One of the first activities that were developed within the collaboration between TGT and the local SMEs was the development of the SME Gastby Clubs, as Table 1 summarises. At the end of 2006 already six clubs were formed (Gastby Tanzania, 2006). To overcome the skill shortage of the indigenous firms participating in the Clubs, TGT implemented a series of training initiatives. The courses fell into two main categories: business management[6] and technology management. For the latter, TGT teamed up with CoET, who developed a course on technological services provided by CoET.

4.2. Technological effort

4.2.1. Process related technological effort

One of the first activities between TGT and CoET was to conduct a survey of a total of 2225 entrepreneurs country wide (Iked, 2006)[7]. The survey revealed that SMEs' major performance problems were due to inefficient equipments, lack of machinery and technologies, as well as absence of market for the products. Since CoET was

[6] The main general management courses were: Networking with service providers, Problem identification and solving, TGTs financial service, Entrepreneurship, Entrepreneurs rights and advocacy, Marketing, Business planning, Management of small businesses, Resource mobilization, Record keeping and Quality assurance

[7] Most of the surveyed firms were in the food sector, textile, metal work and woodwork. Marginally, it also covered other sectors such as construction, electrical works, agriculture, shoemakers, car seat cover makers, solar equipment, mattress makers, pottery, fishing and fishing boat makers, car garages, handcrafts, detergents, plastics, etc. Most of the SMEs were micro-enterprises with less than 5 employees (Iked, 2006).

developing machinery and certain technologies it was decided to assist SMEs absorbing and using that locally developed technology. The transfer of equipment was complemented or facilitated by the introduction of organizational changes.

Additionally, some process-related knowledge transfer took place through student projects. As indicated earlier, students were asked to develop their final projects in issues of relevance for SMEs. Of the different projects, two deserve special attention due to their achievements: the clarification of juice/wine using Pectrinace Enzymes which was adopted by M/s Solar Innovations and another project on the quality of Soymilk as influenced by the Blanching conditions, which was adopted by two companies –Abantu Food Products and M/s Soja Halisi Foods. This student project allowed the firms to reduce of the loss of flour from a milling machine from 20% to only 2%, improving qualities of wine, soya food, solar dried fruits, developing specialized technologies and machinery for some entrepreneurs, etc. Students' consultancy to the specific agricultural units in the country was a contribution into the creation of a link between the research and its application, which is not well developed in Tanzania otherwise.

4.2.1. Product related technological effort

As indicated in the theoretical framework, by product-technological effort we understand those activities conducive to the development of new products[8]. In this

[8] We acknowledge that it is very difficult to draw a line between product and process related innovation activities, particularly in practice. As the literature has acknowledged there is a high degree of complementarity

category, we include R&D, receiving technical specifications for product development or the participation in an incubation program.

The collaboration between TGT and CoET led to the establishment of the **Technology-cum-Business Incubation Program**. This program set up incubators in different locations supporting entrepreneurs in Tanzania with the development of business plans and providing necessary training in technological issues. By the end of 2006, it was also planned to have a hub incubator at UDSM which would provide other incubators with services and help. On a whole, the project can be identified as establishment of permanent linkages with the SMEs for knowledge and technology transfer.

On a more industry-specific level, TGT sponsored a **survey on the housing conditions** in the regions of Rukwa, Mtwara and Zanzibar with the purpose of collecting information conducive to product innovations in the construction industry. The survey helped CoET and TGT to identify details of the poor housing conditions of the low-income inhabitants. Such houses had cold and wet internal conditions, prone to growth of bacteria, fungus and development of viruses; dwellers were exposed to dust emissions, disease outbreaks, insects and discomforts. The survey was followed up by the shelter feasibility project whose main purpose was to assist SMEs in the construction sector to design and build low-cost houses and improve existing constructions. Locally available materials, as well as some technologies developed by CoET were identified and transferred to the SMEs. The project paid

between product and process innovation, that is, for example, organizational innovation are often required when developing a new product.

special attention to the energy efficiency, environmental and sanitary- hygienic conditions. The project has further developed the established linkages with the SMEs by integrating local population and local resources, social needs and new norms, academic research and economy into a new network.

4.3. Building networks

While large firms usually have the resources to access the required technology, hire qualified human resources by their own or introduce new managerial techniques SMEs, especially in developing countries usually need to coordinate collective actions to, for example, share the costs of the acquisition of a machinery that will be used by all, access financial resources, as they will not be able to do it on their own (Chaminade and Vang, 2006). In this sense, supporting the interaction with other SMEs facing similar challenges, might facilitate the exchange of critical knowledge needed for technological innovation.

The initial country-wide SME survey was followed up by a series of local workshops with the participation of both SMEs and other relevant institutions. During these workshops required interventions were identified. These workshops provided a first platform for networking with other SMEs located in the same area although we might expect that the amount of technical knowledge being transferred was rather limited. According to our interviews, regular meetings and contacts contribute to the circulation of achieved capabilities among the participants, encouraging new stakeholders' involvement into activities. Furthermore, our interviewees indicate that

with the increase of interactions, the transfer of organizational and technological knowledge and experience increases among the stakeholders.

These SMEs stakeholders workshops have been complemented by more specific **Technology Development and Transfer Workshops**. The purpose of those workskshops was to create awareness among the stakeholders, as well as identify technical gaps among the SMEs that could then be tackled in collaboration with CoET.

Capabilities = Absorptive capacity	Activities supporting building absorptive capacity	Instruments used for the interaction in the TGT-CoET case	Capability building - results
Awareness	A. Diagnosis or mapping of technological capabilities	Country- wide SME Surveys (3) were aimed at identifying and establishing linkages with existing in Tanzania SMEs. This project provided valuable information on the status and needs of Tanzanian SMEs.	Surveys revealed that SMEs' major problems were the bad performance due to inefficient equipments, lack of machinery and technologies, as well as absence of market for the products. Since CoET is developing machinery and certain technologies it has been decided to assist SMEs with such equipment.
1. Skill base	B. Training	Student projects: students had to develop a project in collaboration with a local agricultural SME. CoET led training programs	Student projects (1) recorded impressive achievements such as reduction of the loss of flour from a milling machine from 20% to only 2%, improving qualities of wine, soja food, solar dried fruits, developing specialized technologies and machinery for some entrepreneurs, etc. SMEs received training on technological services and how CoET could support them in their technological projects
2a. Process-related technological effort	C. Acquisition or improvement of machinery D. Certification / standards E. Technical assistance for technological process		As a consequence of the diagnosis (survey), CoET stared providing SMEs with technical assistance regarding their machinery and helping SMEs to introduce organizational changes.

	F. Technical assistance for organizational innovation		
2b. Product-related technological effort	G. R&D H. Receiving technical specifications for product development I. Incubators	Provision of information for the development of new products Incubators	The survey on the housing conditions in the regions of Rukwa, Mtwara and ZanzibarI identified details of the poor housing conditions of the low-income inhabitants. That information was passed both to SMEs in the construction industry as well as to CoET. A joint research project between CoEt and SMEs is assisting SMEs to construct low-cost houses and make improvements the constructions. Some technologies developed by CoET have been identified and integrated into the process; The Technology-cum-Business Incubation Program is establishing incubators in different locations that will support clients in Tanzania with the development of business plans and provide necessary training in technological issues.
3. Networks	J. Workshops	SME (Gatsby) Clubs Technology workshops	SME Gastby Clubs were created in different regions in Tanzania, embracing more than 800 members. The Clubs provided the platform for the exchange of technological knowledge and experience. The member SMEs also participated in Technology Workshops.

Table 1: Building absorptive capacity*

* it should be noted that the selected activities are not meant to be exhaustive, but are instead those that we identified as contributing to building absorptive capacity in the collaboration.

4. Conclusions and further research

The Tanzanian IS is weak to a great extent due to insufficiently developed linkages and flows of information. In order to accumulate technological capabilities, including absorptive capacity, a properly functioning infrastructure is needed. Indeed, the linkages between the organizations in the IS are essential for building capabilities. In this respect, we have highlighted the important role of intermediates to link different organizations in the IS and to enable and assist in transferring knowledge and technology between them. As the case study shows, TGT performs such crucial task as mediator between CoET and a group of indigenous SMEs. Our case has illustrated that knowledge as well as specific technologies developed by students have been transferred via TGT to the indigenous SMEs.

More specifically, the outcome of the learning processes in these linkages has resulted in awareness and apparent increase of productivity, knowledge and technology diffusions. Also, increase in production efficiency, decrease in loss of crops and more competent SMEs and entrepreneurs was the result of the cooperation. We have identified 11 particular activities in the collaboration that contributed to building selected key elements (skill base, process related technological effort, product related technological effort and networks) of the absorptive capacity. With this the paper contributes to the literature by examining *how* absorptive capacity can be built in IS in least developed countries. This points also to a more general element in the making of IS in least developed countries:

intermediate organizations fulfill an essential task in linking the various components of an IS and hence in building more properly functioning IS.

Further research on the impact of those new competences on innovation (adoption of technology and acquisition of knowledge) and growth will be needed.

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