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Technology Transfer and Technological Capability Building in Informal Firms in Tanzania

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LUND UNIVERSITY

CIRCLE

Thesis for the degree of Doctor of Philosophy

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Technology transfer and technological capability building in informal firms in Tanzania

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When in Africa we speak and dream of and work for, a rebirth of that continent as a full participant in the affairs of the world in the next century, we are deeply conscious of how dependent that is on the mobilization and strengthening of the continent 's resources of learning.

Nelson Mandela.

Abstract

Technology transfer is important to understand how knowledge is transformed to economic value. Applying a case study approach, this thesis investigates the technology transfer efforts from the University of Dar Es Salaam to indigenous informal SMEs in Tanzania and examines the impact of one of their technology transfer mechanisms on the specific technological capabilities that were acquired at the firm level. This dissertation thus aims to contribute to the literature on technology transfer and technological capability building in Africa.

Theoretically, the thesis relates to the many remaining blind spots in the emerging area of innovation studies and university-industry linkages with regard to technology transfer from the formal to the informal economic sphere in developing countries, particularly least developed countries in Africa. The thesis aims to contribute theoretically to the field of technology transfer by a) discussing how technology transfer to the informal economy can occur, where the innovation system is highly fragmented, and b) examining how technology transfer can support the building of technological capabilities in informal firms in such weak innovation systems. An analytical framework based on different levels and functions of technological capabilities is developed to this end.

Empirically, this dissertation is based on data collected through a survey and interviews on site in Tanzania during 2008 and 2009. While technological capabilities were acquired on all levels, the findings reveal that the categories may relate to more basic activities on all levels. The results further show that the different technology transfer mechanisms differ with regard to the technological capabilities that they may generate as a result of the transfer. Overall, the transfer of technology to the informal firms is more complex in terms of the external organizations that are involved and is in contrast to more linear relationships identified in technology transfer literature.

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Lund, January 2010

Astrid Szogs

List of acronyms and abbreviations

BET	Board of External Trade
BICO	Bureau for Industrial Cooperation
BRELA	Business Registration and Licensing Agency
CAMARTEC	Center for Agricultural Mechanization and Rural Technology
CDO	Community Based Organizations
CEBE	Faculty of Civil Engineering and Built Environment
COSTECH	Commission for Science and Technology
CoET	College of Engineering and Technology
DCAD	Delaware College of Art and Design
ECSE	Electrical and Computer Systems Engineering
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
GDP	Gross domestic product
HSRC	South African Human Sciences Research Council
ICLS	International Conference of Labour Statistics
IS	Innovation system
ILO	International Labour Organization
LDCs	Least developed countries
MECHE	Mechanical and Chemical Engineering
MGPARI	Marcus Garvey Pan-African Institute
MNE	Multinational Enterprise
NBS	National Bureau of Statistics
NEPAD	The New Partnership for Africa's Development
NGO	Non-Governmental Organization
NISER	Nigerian Institute of Social and Economic Research
NSI	National System of Innovation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
SARUA	Southern African Regional Universities Association
SENGONET	Sengerema Non-Governmental Network
SIDO	Small Industries Development Organization

SMEs	Micro Small and Medium Sized Enterprises
STI	Science, Technology and Innovation
TBS	Tanzania Bureau of Standards
TC	Technological capabilities
TCCIA	Tanzania Chamber of Commerce, Industry and Agriculture
TDTC	Technology Development and Transfer Center
TEMDO	The Tanzania Education and Micro Business Opportunity
TGT	Tanzania Gatsby Club and Development
TIRDO	Tanzania Industrial Research and Development Organization
TISCO	Tanzania Industrial Studies and Consulting Organization
UDSM	University of Dar es Salaam
UIS	Unesco Institute for Statistics
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UniDEV	The evolving role of academic institutions in innovations systems
UNIDO	United Nations Industrial Development Organisation

1 INTRODUCTION

1.1 Background and motivation for the research

This dissertation examines the transfer of technology and knowledge between a university and a set of SMEs in the informal sector in Tanzania and the extent of technological capability (TC) building that this transfer generates. By studying this, the thesis also aims to investigate the applicability of existing frameworks for the analysis of technology transfer to a context of informality in a least developed country (LDC)[1] in Africa[2].

This PhD thesis is written within the interdisciplinary field of innovation studies. It is motivated by a deep concern with the underdevelopment of some countries in Africa, particularly Tanzania, and it is grounded in the idea that the accumulation of capabilities at the individual and organizational level is paramount for the catching up of these least developed countries.

---

1 Since 1971, the United Nations has termed a certain category of states that are highly disadvantageously "equipped" regarding their development process and are struggling more than other countries and failing to escape their poverty as "Least Developed Countries" (LDCs). LDCs are seen to be in extreme need of attention from the international community. In the years 1981, 1990 and 2001, United Nations Conferences on the Least Developed Countries were held under the leadership of UNCTAD. The 2001 conference in Brussels agreed on the specific "Programme of Action for the Least Developed Countries for the decade 2001-2010". On the basis of specific criteria that consider the structural problems of these countries, the UN signals to the development partners where particular international support is needed. Tanzania belongs to this list of LDCs, and therefore the term LDCs is used in this thesis when referring to the characteristics of this group of countries in general, and Tanzania in particular (a different type of classification is made by the World Bank which differentiates low-income economies, lower-middle-income economies, upper-middle-income economies, high-income economies and high-income OECD members. Tanzania belongs to the current 43 states of the low-income economies).

2 Problems often arise "when the aid agencies work and strategy recommendations are based on the assumption that the research theories, methods and strategies that have shown to be useful in highly industrialized countries can be applied, without modification, to countries with totally different structures, internal conditions and relations to the international system" (Martinussen, 1997: 4).

Debates about the problems concerning how the poorest countries in the world can economically develop are among today's most widely debated topics. Researchers and experts of many different disciplines ranging from economics, sociology, and politics to engineering and anthropology among others have attempted to understand the causes and remedies of poverty and underdevelopment. Yet, the only consensus that has been reached is that the causes and nature of poverty and underdevelopment are a set of highly complex factors and straightforward or fast remedies do not exist (Ghatak, 2003).

Different schools of economic thought (classical, historical, institutional, Marxian, Keynesian and neoclassical) have addressed the challenge of development, particularly the specific sub-discipline of development economics which emerged during the post World War II period. The main issues of development economics have been concerned with the sources of economic development, the origin of the "wealth of nations" and various factors that enable and promote development. Still economic development has been a major concern of economists in all history of economic thought, since pre-Smithian times to classical development economics in the post World War II era (Jomo and Reinert, 2005). Despite this long tradition, there is no consensus regarding "why economic development by its very nature seems to be so unevenly distributed" (Reinert, 2007: 3).

This very long tradition of thought on economic growth and development is the broader frame of this thesis, as is the insight from these schools of thought that the process of economic development is rather unevenly distributed due to its embeddedness in a variety of human capital endowments, firms and technologies which happens to be unevenly distributed across countries, regions and even firms (Dolfsma et al., 2008).

The above statement about the uneven distribution of human capital, technology and firms as the possible root of underdevelopment points to the positive correlation between innovation and economic growth (Nelson and Winter, 1982; Nelson, 1993; Lundvall, 1992). Learning and innovation are key determinants of growth and competitiveness of nations, regions, clusters and firms both in developed as well as in

developing countries in general and LDCs in particular (e.g. Lundvall et al., 2009; Muchie et al., 2003; UNCTAD 2007; UNDP, 2005).

Innovation studies aim to understand how innovation can support economic growth, development and catching up also in LDCs (Lundvall et al., 2009; Muchie et al., 2003; Mytelka, 1993; Ernst and Lundvall, 1997; Arocena and Sutz, 1999; Johnson and Segura-Bonilla, 2001). From the early studies on innovation in developing countries, it is possible to distinguish between two different groups of scholars; those that highlight the importance of exploiting and adapting technologies that have been developed abroad, and those that emphasize the importance of building indigenous capabilities through a more internally driven process.

The literature on foreign direct investment (FDI) and multinational enterprises (MNEs) spillovers (Lall, 1996; Narula and Marin, 2005; Narula, 2001; Narula and Dunning, 2000; Cantwell, 1994; Chen 1996; Dunning, 1993) has been clearly focused on the acquisition of skills and technologies from developed countries. However, the impact of FDI and foreign technology sources on the building of domestic capabilities depends on a variety of factors (Schmitz, 1999, 2004, 2006; Humphrey and Schmitz, 2000; Kaplinsky, 2000; Kaplinsky, 2002; Gereffi, 1994, 1996; Gereffi and Kaplinsky, 2001). One of the most important ones being the local firms' absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002; OECD, 2002) or, in other words, their level of technological capabilities (Bell and Pavitt, 1993; Dahlman, 1987; Katz, 1987; Lall, 1987, 1992, 2001) and their ability to learn.

It can be argued that the relative lack of success of some economic strategies that are based on attracting FDI and relying on external sources of knowledge has renewed the scholars' and practitioners' interests in the endogenous sources of growth[3]. This has coincided with a global open debate on the role of academic institutions in growth and development (Brundenius and Göransson, *forthcoming*; Brundenius et al., 2009; Arocena and Sutz, 2001) of the "entrepreneurial universities" and the increased emphasis on the "third mission" of universities, i.e.

3 It should be noted that the emphasis is on renewing the interest, as the debate on the endogenous sources of growth has largely been dominating the development economics literature.

commercialization of research results that are of relevance to society at large. Hence, universities emerge as crucial players in innovation systems and as providers of not only human capital, but also of entrepreneurs and potentially transferrable technologies.

While the emerging literature in this field has derived from a developed country context, it is also a very relevant issue for countries at lower levels of economic development. Universities in developing countries can play a role in building capabilities in the innovation system of developing and least developed countries under certain conditions (Brundenius and Göransson, *forthcoming*; Brundenius et al., 2009). This is the point of departure of this thesis.

In industrialized countries, research has demonstrated that independently of the source of knowledge (exogenous or endogenous) the ability to learn (OECD 1996a, 1996b, 1996c; Lundvall and Johnson 1994; Lundvall 1994, 1996) is strongly influenced by the socio-economic context in which the organizations are embedded; it is the ability to learn that ultimately determines firms', regions' or countries' capacities to grow.

At present, empirical and theoretical material that deals with the realities and types of innovation and innovation systems in Africa is still limited, and research in this area is emerging (e.g. Muchie et al., 2003; Lundvall et al., 2009; Oyelaran-Oyeyinka and McCormick, 2007)[4]. In Africa, and despite the heterogeneity between African countries, the socio-economic context is characterized by a very low ratio of income to population, which is related to low levels of saving, investment and backward technology as well as low productivity; high unemployment is due to population pressure and the lack of job opportunities.

A significant part of the employed population earns an annual income between $50 and $75 predominantly from agriculture which often accounts for 45-90% of the total output and for 60-95% of the total employment (Ghatak, 2003: 19). Thus, the development and economic growth of these countries are closely linked to the overall development

4 A complete discussion on the concept of innovation systems and its applicability to developing countries is provided in the following chapter.

of the agricultural sector which is characterized by a very high degree of informality.

Nevertheless, innovation is as important for low income countries as it is for developed countries (Chaminade et al., 2009). The low incomes that characterize developing countries are a result of their low average productivity, reflecting "their limited capacity to develop new or to adopt and improve upon existing technologies" (Altenburg, 2008: 2). In Africa, technological capabilities are often not well developed, and firms in LDCs are typically characterized by very low levels of technological capabilities. Hence, examining the mechanisms that enable the adoption, mastering and improvement of technologies can be an important focus of innovation system research in Africa. It thus becomes crucial to investigate how (what mechanisms) and what type of TCs that can be built as a result of interactions (as e.g. university–industry).

Hitherto, most studies within the field of innovation studies, university-industry linkages and technology transfer in particular deal with the functioning, mapping and analyzing of the formal economic spheres. Since these concepts derive from developed countries, this is not surprising. However, in LDCs, on the contrary, the economies are dominated by a high degree of informality. This mere fact calls for attention for the dynamics of technological learning and innovation even in the informal sector – where "firms" operate under different norms and rules than in the formal economic sphere. As a high amount of firms in LDCs, and in Tanzania in particular, is informal, it is highly essential to study how these firms acquire technological capabilities.

The thesis focuses particularly on the transfer of technology to firms in the informal sector. With this dissertation, I provide some evidence on how interactive learning and capability building can take place when universities engage in technology transfer programs with firms in the informal economy.

In summary, there are several theoretical interrelated factors that motivated and justified this research:

- The underlying hypothesis that learning and capability accumulation are at the core of development and growth.

- The predominantly theoretical focus on catching up and technology transfer as well as technological capability building literature on external knowledge and technology as opposed to endogenous knowledge and technology.

- The almost exclusive focus of the technology transfer literature on interactions in the formal economy.

- The scarcity of studies on innovation in least developed countries, particularly in the African continent.

It is particularly interesting to study these issues in Tanzania because of the following points:

- In Tanzania, technological change and the technological learning efforts have not been prioritized (e.g. Wangwe, 1993). Technological capabilities in Tanzania remained low also in the period after reforming policies[5] which a study investigating the early phase of the industrial restructuring process in Tanzania revealed (Wangwe, 1992).

- As in most other LDCs and many developing countries, in Tanzania a very large amount of all economic activities is taking place in the so-called informal economy, which is beyond any state control and statistics, and hence difficult to grasp. It has – despite of its dominance in terms of income and employment – been comparatively neglected, and an understanding of the dynamics, mechanisms, technological learning efforts and types of technology transfer from formal to informal, etc. in this big black box is therefore very important.

5 A more detailed overview of policies and their changes in Tanzania will be presented in the specific chapter on Tanzania (chapter 6).

- The informal economy is comprised of most of the SMEs[6] in Tanzania, and therefore it offers a relevant case to study technology transfer to and capability building in informal SMEs.

- Not the least, Tanzania is an interesting case to illustrate and study these points, not only because these issues have basically not been addressed in an African context, but also because Tanzania has experiences in technology transfer and capability building between university and a group of informal SMEs. Thus, it provides a good opportunity to study these specific mechanisms from the theoretical lens of the literature in this field and investigate whether the literature is adequate in the specific context in a country with an emerging innovation system and a comparatively low economically developed level.

This thesis studies these challenges with an analysis of technology transfer from a university to informal firms in Tanzania and the technological capabilities resulting from these transfer processes. The thesis is therefore placed within the field of university-industry relations and the technology transfer occurring in this relation. The following section presents the objectives and research questions of this dissertation which were derived from this background of the study and further developed throughout the following chapters.

1.2 Aim, contribution and scope of the research

1.2.1 Research questions and objectives of the research

This dissertation aims to contribute to the literature on technology transfer and technological capability building in Africa by studying these

6 The acronym SME refers in this dissertation and following Katalambula et al., (2006) to micro, small and medium enterprises. Usually the acronym MSMEs is used to refer to micro, small and medium enterprises. Different measures of size depending on level of development can be found in different countries; commonly adopted yardsticks are total number of employees, total investment and sales turnover. In the specific case of Tanzania firms engaging up to 4 people are micro enterprises. These are often family enterprises. Most of the micro enterprises belong to the informal sector. In the case of the TGT/CoET collaboration the term SMEs is used for the collaborating firms, even those employing more than 4 persons.

aspects in relation to indigenous, informal SMEs that engage in interactions with the University of Dar es Salaam.

Based on the previous discussion, the specific guiding research questions are:

- What technology transfer mechanisms exist between a university and informal firms in Tanzania?

- What types of technological capabilities have been acquired by informal SMEs as a result of participation in one of the specific technology transfer mechanisms?

- How have these technological capabilities been acquired?

This is investigated by studying the collaboration between the Tanzania Gatsby Club (TGT) and the College of Engineering (CoET) at the University of Dar Es Salaam with respect to their technology transfer efforts from the university to SMEs, and by examining the impact of one of their technology transfer mechanisms (Gatsby Club) on the specific technological capabilities that were acquired at the firm level.

When analyzing the technology transfer, different mechanisms are identified and examined, and the TCs are distinguished in different levels ranging from basic, over intermediate to advanced capabilities, and they are grouped into categories of production capabilities, investment capabilities and linkage capabilities.

The contribution of this research can be specified according to its **policy relevance**, **theoretical**, **empirical, analytical** and **methodological relevance**. First, from a policy perspective we can observe a shift in development aid policies. There is currently a growing focus on how to strengthen capability building in LDCs, also in Africa, and these efforts highlight the crucial role of innovation activities.

The **theoretical relevance** of this dissertation relates to the many remaining black boxes and blind spots in the emerging area of innovation studies and university-industry linkages examining technology transfer from the formal to the informal economic sphere in developing

countries, particularly least developed countries in Africa. As discussed in previous sections, the thesis aims to contribute theoretically to the literature on technology transfer by a) discussing how technology transfer can occur in the informal economy and b) examining how technology transfer can support the building of technological capabilities in informal firms.

Its **empirical relevance** lies in the application of these issues to Tanzania, where little of this work has been done. Due to the very high percentage of informality in Tanzania, much economic data on for instance public R&D expenditure and on firm statistics is not readily available, as the informal economic activities are those that are not registered anywhere and beyond any state assessment. This absence of statistics from various levels and areas has also led to the rather descriptive studies of these emerging STI systems and assessment of whether the implementation of certain policies has been successful, etc. This dissertation is based on novel data collected in site in Tanzania during 2008 and 2009. It provides unique insights into potential technology transfer mechanisms to informal SMEs and the impact on capability building.

Applying the concepts of different TC levels in a LDC context, the dissertation proposes a novel **analytical framework**. The high degree of informality that characterizes LDCs has posed several **methodological challenges**.

1.2.2 Boundaries to and limitations of the thesis

This thesis is based on the empirical material collected in Tanzania. It provides some insights into the technology transfer mechanisms from one particular university to informal firms in different industries in Tanzania and the technological capabilities that have been acquired as a result of the technology transfer. Thus, based on the limited empirics, the following can be analyzed: a) the technology transfer mechanisms from the University of Dar es Salaam to informal enterprises and b) the resulting technological capabilities. The implications of the case on technology transfer and technological capability building in Africa in

general or more broadly on university–industry linkages or innovation systems are thus limited.

Moreover, concerning the boundaries of this thesis it should be specified that the thesis does not aim to contribute to development economics and development theories. Nor does the thesis contribute directly to innovation system theory, even though it frames the broader context of this research, and some of the findings may be related to the research on innovation systems in Africa. The core dialogue is with the technology transfer and technological capabilities' literature within a university-industry interaction.

The empirical evidence provided in this thesis is based on a set of informal firms. The discussions on the differences between technology transfer in the formal and informal economy in the thesis are not based on collected data in formal as well as informal firms but rather on contrasting my evidence with the existing literature on technology transfer (which is based on transfers in the formal economy).

Another limitation of the thesis can be seen in the selection of only one specific Gatsby Club in Tanzania, namely Tanzania Gatsby Club. In terms of in-depth study possibilities, time frame, accessibility, cooperation (help with questionnaires and interviews, etc.), it was not possible to study another Gatsby Club for comparative reasons.

It would have been interesting to investigate industry differences as regards the types of TCs that have been acquired. This was initially planned, and cross analysis of findings as regards industry belonging was performed. However, during the interviews with the firms, it turned out that many of the firms that had specified a particular industry belonging were in fact performing a number of different activities that belong to more than one industry, and therefore industry comparisons were not possible.

1.3 Structure of the thesis

This monograph is structured as follows.

The first chapter introduced and contextualized the research and the research questions and justified the choice of topic and problem in terms of its policy, theoretical, analytical and methodological relevance.

Chapters two and three present the theoretical foundation of this thesis, starting with innovation and innovation systems in LDCs (chapter two) and continuing with technology transfer and technological capability building (chapter three).

The analytical framework is developed in chapter four for the purpose of investigating the technological capabilities in indigenous SMEs of the Sengerema Gatsby Club in Tanzania.

Chapter five deals with methodological issues. The rationale for the choice of a combined qualitative and quantitative research design is discussed as well as the choice of the cases and methods for the collection and analysis of the data presented.

Chapter six provides some key macro statistics on Tanzania and thus gives a picture of the political economy of the country in which the technology transfer and TC building are studied.

The following chapter seven describes some background information of the case of TGT and CoET collaboration with informal SMEs and identifies and describes three specific channels of technology transfer.

Chapter eight presents and analyzes the findings of the empirical material regarding TC improvement and acquisition through a particular Gatsby Club.

The final chapter provides the conclusions of the analysis along with policy implications and issues for future research.

2 INNOVATION FOR DEVELOPMENT

This chapter and the next chapter provide a short review of the literature applied in this thesis, which is synthesized into an analytical framework in chapter four. This chapter starts with a synthesis of the concept of innovation, it then draws attention to why innovation is crucial for development and continues with an elaboration of the concept of innovation systems and its applicability in LDCs. From there the discussion moves to specific actors within the system and the emerging area of the role of universities and its linkages to industry.

2.1 The concept of innovation

The Renaissance philosophers who contributed to spread Renaissance economic thinking throughout Europe gave birth to the term "innovation" as used in economic theories even today. Massive creativity was liberated during this time through outstanding artists and scientists as Michelangelo, da Vinci, Rafael, Kepler and Copernicus which also had an impact and consequences for economics (Reinert, 2007).

Around 1605, Francis Bacon wrote "An essay on innovations", and as the "scientific leader of the new industrialists" he advocated to apply science in the production of manufactured goods (Crowther, 1960). Francis Bacon's early emphasis on the importance of scientific knowledge was analogous to the one we can find far more than 200 years later expressed by Friedrich List: "Industry is the mother and father of science, literature, the arts, enlightenment, useful institutions and national power… The greater the advance in scientific knowledge, the more numerous will be the new inventions which save labor and raw materials and lead to new products and processes" (List, 1904: 66-7).

At the heart of this focus lies the contention that learning and innovation understood in a broad manner[7] are key determinants of growth, competitiveness of nations, regions, clusters and firms. The effectiveness

7 A broad definition includes capability building (Lundvall et al., 2009).

of learning and the way knowledge can be turned into value, i.e. innovations can arise, are affected by firm specificities and the specific innovation system in which the firms are embedded. These notions have lead to an innovation buzz among academics, policy makers and financers across the globe (e.g. UN Millennium Project 2005; UNCTAD 2007; UNDP 2005; UNIDO, 2009; World Bank 2008; Fagerberg, 2005).

Although the concepts of knowledge, invention or innovation are often used indistinctively in policy documents, conceptually they are rather different. It is the diffusion of innovation and not the invention that has a clear impact on growth. As acknowledged by Schumpeter (Schumpeter, 1939), a few inventions alone do not generate major changes in the world, while the widespread diffusion of innovations can. An invention of new products or processes takes place within the "technoscientific" sphere in which it could always remain. An innovation, on the contrary, is an economic fact. By commercially introducing an innovation, it is transferred into the techno-economic sphere, its success is later decided in the market, and extensive diffusion is "what really transforms what was once an invention into a socio-economic phenomenon" (Perez, 2007: 219). Thus, while inventions can occur at any time, not all of them become innovations and not all of them are widely diffused. It is also important in this respect that what is technically feasible is not always economically profitable. It is thus important to understand how innovations can be diffused. For this it is helpful to distinguish between classifications of innovations that allow differentiation of the economic and social aspects and factors conditioning the diffusion of innovations.

Most definitions of innovation refer to the successful application of new knowledge in products and processes. A useful classification is the differentiation between incremental and radical innovations. Incremental innovations are consecutive changes and improvements in already existing processes and products. In contrast to this, a radical innovation is when an entirely new process or product is introduced. Product and process differentiations are another crucial part of the definition of technological innovation. In addition to technological innovation (in form of product innovations and process innovation), marketing innovations and organizational innovations are also the main types of

innovations that stand out in the Oslo Manual (OECD, 2005)[8]. Importantly, technological innovations are to be distinguished from and not mixed with technological knowledge which is the focus of the transfer of technology in this thesis.

Thus, the focus is on novelty and newness. The OECD definition defines three different levels of "new": "new to the world", "new to the country" and "new to firm" (OECD, 1996).

While it is possible to find new to the world and radical innovations in the developed world, in a developing country context, innovations are mainly of incremental nature (for instance, the first South African innovation survey found that 86% of innovations in the South African industry were incremental) and are often the results of adaptations of knowledge developed elsewhere; they may be new to the firm or the country rather than new to the world. Many incremental innovations result from interactions with foreign affiliates of MNEs, and sufficient technological capabilities need to be present for the successful adaptation, implementation and creation of new technologies (e.g. Bell and Pavitt, 1993; Lall, 1993; Cantwell, 1989). Further, the characteristics of innovation in developing countries are the size and structure of the market where most firms operate at suboptimal production scales with high costs and far from optimal efficiency. The exploitation of natural resources and cheap labor are the main factors of competitiveness instead of differentiated products or efficiency.

Macroeconomic instability and uncertainty, a fragile institutional framework, lack of public policy instruments to support business and management training, lack of physical infrastructure (electricity, old ICTs) and high informality are key features of the innovation landscape which needs to be taken into account when attempting to measure innovation in these countries.

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8 The first and second edition of the Oslo manual only used the technological product and process innovation definition with a focus on the technological development of new products and production techniques by firms as well as the diffusion to other firms. Organisational and non-technological innovation was only included in an annex. This has been changed in the third edition of the manual.

Due to these different characteristics of the innovation process in developing countries, adaptations of the proposed methods in the Oslo manual had to be made. The first attempt to assemble different particularities and assist in the design of comparable cross national innovation surveys was done in Latin America by the Ibero-American Network on Science and Technology Indicators (RICYT). This resulted in the publication of the Bogota Manual for Standardisation of Indicators and Technological Innovation in Latin American and Caribbean Countries (RICYT 2001). The Bogota Manual has later been used for most of the innovation surveys that were conducted in Latin American countries and also extended to other regions. This important work has stimulated the production of annex A in the third edition of the Oslo Manual (2005) which is explicitly devoted to innovation surveys in developing countries (OECD 2005).

Following the Bogota manual and the annex A of the Oslo Manual, there are four key characteristics of the innovation process in developing countries. These are a) the acquisition of embodied technology (equipment) for product and process innovation is a main component of innovation; b) minor or incremental changes are the most frequent type of innovation along with innovative applications of already existing products and processes; c) in all countries, organizational change is crucial in the innovation process as it contributes to the firm's ability to absorb new technologies that are incorporated in machinery and other equipment; and d) innovation in the agricultural sector has a high economic impact due to the overall economic weight of the sector. Points a, b and d are the components of the definition of innovation in the LDC studied in this thesis.

2.2 Studying innovation from a system perspective

The study of interactions between various public and private actors and how that may lead to the generation and diffusion of innovation has been the focus of the system of innovation approach (Freeman, 1987; Lundvall, 1988 and 1992; Nelson, 1993; Edquist, 1997; Johnson, 1992) where an innovation system is defined as "all important economic, social, political, organizational, institutional and other factors that

influence the development, diffusion and use of innovations" (Edquist 1997: 14).

The main idea of the innovation system approach is that not only the capabilities of the individual firms matter, but the interactions among firms, research institutes, universities, government and formal and informal institutions, such as laws, regulations and routines in a system, determine the innovation capacity of a country or a region[9] (Nelson and Winter, 1982; Lundvall, 1992; Freeman, 1988; Edquist, 1997)[10]. These interactions are of crucial importance in order to effectively absorb and assimilate knowledge and technologies. Hence, one may state that the innovation system approach can be seen as "a way of analyzing innovations – their character, their causes and how they affect economic growth and development – in the learning economy" (Johnson and Segura-Bonilla, 2001: 5).

This group of authors argues that the actors in a system and the networks and interactions between them are of major importance. These actors may be, e.g., individuals, firms, producer groups or governments. Innovations "are rooted both in the production structure and the institutional set-up of the economy" (Johnson, 1992: 34). The interactions among these actors are shaped by the institutional set-up of a given country, which influences the way technical change can take place, but also the specificities of product and market development and firm growth.

There are several scales of analysis of innovation system approaches. These versions vary with regards to their main focus. Concepts of "regional", "sectoral", "national" or simply "innovation system" are common among the different system approaches (Breschi and Malerba, 1997; Freeman, 1987; Lundvall, 1992; Nelson, 1993; Edquist, 1997). If

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9 A related concept is that of triple helix which addresses the university-industry-government relations (developed by Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2000) and aims to explain how innovation in knowledge based economies come about.

10 Nelson and Winter (1982) suggested an innovation system approach as an alternative framework in economic theory to the neo-classical framework as a response to and building on critics of the mainstream economic thinking which stems mainly from Veblen, 1909, and Schumpeter, 1911, 1942.

we talk about a national system of innovation, the national aspects imply that the different components and relationships are located or rooted within a nation state. Empirical evidence has shown that industrial activity varies within different nations. This also holds for regional innovation systems which are defined by a geographical area; in such a definition, national borders are suggested to play a minor role in the system. Other system approaches have left the geographical dimension and claimed that the context of sector specific (Malerba, 2002; Malerba, 2004) or technology specific (Carlsson and Stankiewicz 1991) elements are essential for an understanding of innovation from a system perspective.

A common element of all these contributions was that they differed from the linear view on technological innovation and considered innovation at micro, meso and macro levels as the key force for economic development. A further characteristic was their broad perspective on innovation, including a focus on interactive learning and competence building (Lundvall et al., 2009).

There are two different perspectives in innovation system research, a narrow and a broad one. The narrow one has reduced innovation to science and technology, while the broad view also includes learning and competence building at various aggregate levels (Lundvall et al., 2002; Lundvall, 2007). Thus, in a narrower definition, only the science and technology organizations are included. In contrast, the broad definition considers a larger set of organizations, and hence social institutions, financial systems, education and communication infrastructures and macro economic regulation are all regarded as impacting the interactive learning and competence building process (Gu and Lundvall, 2006). It is this broader definition which is more interesting for developing countries.

The innovation system literature distinguishes between two different forms of learning: learning by doing and interacting and learning through science and technology. These relate to the STI (Science, Technology and Innovation) and DUI (Doing, Using and Interacting) modes of innovation (Jensen et al., 2007; Lundvall 2007). The STI mode relates to a narrow definition of innovation systems with its focus on innovation which stems from R&D efforts emphasising on codification of

knowledge obtained e.g. through experimentation in labs. However, the DUI mode of the learning and innovation process refers to learning on the job through problem solving and interacting with external customers, and through its emphasis on learning in various relationships, it connects to the broader definition of the innovation system.

Most innovation studies are criticized for their narrow approach to innovation, only stressing the scientific knowledge. In developing countries, the non-scientific forms of learning appear particularly important. Furthermore, given the weakness or even absence of linkages among various actors in the innovation system in most LDCs, there are only highly limited opportunities for spontaneous, interactive learning processes to occur. In addition to the lack of resources, the inadequate socio-economic infrastructure, poverty, corruption, etc., this puts further constraints on innovation and development. Therefore, various mechanisms that can serve as facilitators for interactions (for learning processes) are very important steps in providing an environment that supports TC building and upgrading.

There has been concern that a framework like NSI with its explicit focus on innovation is not suitable in developing and least developed countries. This is based on the assumption that these countries do not innovate in the stricter sense of the word, but are users of innovations that were created elsewhere (Lall and Pietrobelli, 2002; Viotti, 2002).

Innovation systems in LDCs can be characterized by their different dynamics (exogenous versus endogenous) as they often strongly depend on external sources of knowledge and financing (Muchie et al., 2003; Morrison et al., 2008; Arocena and Sutz, 2000; Pietrobelli and Rabellotti, 2007; Pietrobelli and Rabellotti, 2008; Humphrey and Schmitz, 2000, 2002 and 2002a; Kaplinsky, 2000). In LDCs, multinational enterprises have been much studied as potential, important sources of knowledge and technology (e.g. Dicken, 2003; Dunning, 1993; Reddy, 2000; Lall and Narula, 2004; Marin and Bell, 2006).

As LDCs do not have the same resources as developed countries, they need to be more open. The main concern of LDCs is the import, imitation, assimilation and improvement of technologies that are already

developed and available from elsewhere (e.g. Archibugi and Michie, 1997).

Moreover, another key difference between developed and developing countries' innovation systems is that in LDCs the linkages between the various actors are of rather sporadic nature, which leads to more fragmented systems (Narula, 2002). The institutional infrastructure in developing countries differs immensely from that of developed countries and is most often characterized by institutional inappropriateness and inadequacy to foster innovative activities and lack of physical and human resources. When dealing with innovation systems in developing countries, the focus, therefore, is and should be mainly on the making of these systems; on understanding how to build efficient innovation systems rather than mapping already existing systems in the various countries.[11]

Countries are able to upgrade if an innovation friendly environment exists, i.e. an environment that facilitates interactive learning mechanisms in which innovations can come about. In a LDC context, the factors that determine industrial success have also been referred to as comprising a "national industrial learning system" (Viotti, 2002), whereby "the main elements interact with each other in a systematic way to influence enterprise capability development" (Lall, 2002: 7). Lall has used this concept as being similar to that of NSI (Nelson, 1993; Freeman, 1995; Lundvall, 1992)[12]. The emphasis on *learning* systems has been preferred to accent LDCs main concern with the mastering and use of existing technologies rather than with the generation of new innovations.

In a similar vein, some other authors have coined the term "National *Technology* Systems" (NTS) (Lall and Pietrobelli, 2002) to emphasize the importance of building technological and financial capabilities, managing the diffusion process, adopting and modifying technologies.

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11 Muchie et al. (2003) have provided several examples of the making of innovation systems in different African countries and how the concept of national systems of innovation can be applied in Africa.

12 Importantly, it has been argued that the innovation system approach represents a weakness when applied to the realities of developing countries as regards how political aspects and power dimensions of development are treated (e.g. Johnson & Segura-Bonilla, 2001: 7).

The differences between NTS and NIS have been extensively discussed by Muchie and Baskaran (2008). The authors analyze the gaps and weaknesses as well as overall aim and underlying assumptions of both the NTS and the NIS in relation to LDCs' need to integrate with the world economy and to upgrade. They point out that the NIS applied in LDCs and developing countries may implicitly dichotomize or reinforce a relation between, on the one hand, those who create technology and innovations and, on the other hand, those who acquire innovations from technological leaders and adapt it to local needs and use.

Furthermore, a difference between these approaches may be a varying emphasis regarding "the relationship between the difference on building internal capability for endogenous science and technology, and for absorbing new technology from the world circuits" (Muchie and Baskaran, 2008: 7).

In order to promote an inclusive concept that allows developing countries to be understood as both suppliers of innovation and absorbers of elsewhere created technologies, Muchie and Baskaran propose a framework that combines the various internal and external, domestic and foreign capabilities in a "national innovation learning and development system" (NILDS). Thus, by introducing the NILDS, the two researchers have further broadened the NSI framework (even the broader notion of the NSI concept as generated by Lundvall and colleagues has transformed into what they call learning and innovation and competence building systems to allow for an incorporation of development concerns). They argue that "while NSI can be used for any nation in the world, there is a need to develop a specific focus on the distinction between developing country technology-innovation followers and developed country technology-innovation leaders" (Muchie and Baskaran, 2008: 22).

However, to be able to study variations or differences regarding the innovative performance of nations and firms, a common framework is needed. Indeed, the generation of "different *sui-generis* frameworks" derived from different experiences of catching up in different latecomer economies is "non-sequitur, theoretically unsatisfactory, empirically unhelpful, and not constructive for policy" (Lorentzen, 2009 a: 179).

The need to develop new alternative concepts to IS to emphasize the importance of learning and the absorption of technology reflects that IS has been interpreted in a narrow sense. A broad definition of IS is one that encompasses both the creation and adoption of technology, emanating from different forms of interactive learning, including foreign sources (Lundvall et al., 2009). This is the framework in this thesis.

Learning occurs in a variety of interactions. As argued earlier in the introduction, the literature on innovation in developing countries has addressed the role of spillovers from MNEs to local SMEs. The MNEs have often limited incentives to interact with local SMEs due to their lack of resources (Dunning, 1993) and accordingly other forms of interaction become crucial. One is the interaction between indigenous SMEs. Technology transfer and interactive learning are facilitated by geographical proximity, as the role of tacit knowledge is very important, and hence personal ways of communicating and interacting (Lundvall and Borras, 1999). This is the case both in developed (e.g. Asheim et al., 2003) and developing countries (Giuliani, 2004; Giuliani and Bell, 2005; UNIDO 2005; Pietrobelli and Rabellotti, 2007). In developing countries, however, these interactions are often constrained due to corruption, lack of trust and very little differentiated products.

A potentially crucial endogenous source of knowledge that might facilitate upgrading and innovation among indigenous SMEs is universities (Göransson et al., 2009; Göransson and Brundenius, *forthcoming;* Intarakumnerd and Schiller, 2008). Universities have received increasing attention in the innovation studies due to their importance as catalysts for knowledge based growth and contributors to increased innovative performance (Mowery and Sampat, 2005; Etzkowitz and Dzisah, 2007; Brundenius et al., 2008; Brundenius et al., 2009), and the literature on the interactions between universities and industry (Mansfield, 1991, 1998; Salter and Martin, 2001) is constantly growing.

In developing countries, special attention has been paid to their role as providers of qualified human capital as well as of research relevant to the local industry (Mwamila and Diyamett, 2009). Opposed to the technological level of many of the indigenous SMEs, the knowledge at universities might be highly advanced. Universities are increasingly viewed as actors that create and provide knowledge that is applicable for

industrial innovations, and they are therefore main actors in the innovation systems (e.g. Brundenius et al., 2008; Göransson et al., 2009).

While a large body of literature deals with interactions between university and industry (e.g. Mansfield, 1991, 1998; Salter and Martin, 2001; Etzkowitz and Leydesdorff, 2000; Jacob, 2006), its impact on innovation and the innovative performance of firms have not been easy to sketch (Laursen and Salter, 2004; Fagerberg, 2004). Furthermore, the innovation literature has mainly addressed linkages to formal firms. This thesis investigates the learning processes in the interactions between a university and informal SMEs.

Overall, the underlying assumptions in this university-industry interaction are that university-industry linkages need to be strengthened and supported if scientific knowledge is to be used for innovations. More specifically, universities can supply crucial knowledge to the industry in form of e.g. scientific and technological knowledge, human capital, specific skills, instruments, prototypes for new products and processes as well as network of scientific and technological capabilities (Mowery and Sampat, 2005). However, as a response to this increasing interest in universities and their contribution to the development of different innovation systems and rising attention on the "third task", concern has been expressed that stimulating the collaborations with industry extensively might derive academia of resources and remove focus from the core activities of research and training (Lundvall, 2002)[13].

The next chapter takes a closer look at what technology transfer encompasses in general and in university-industry interaction in particular, and how technological capabilities are related to this and defined and used in this thesis.

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13 The current debates on the role of the universities in innovation systems and in generating economic development are primarily based on cases from the developed world and to a lesser extent applied in the context of developing countries (interesting material in this respect is available through the UniDev project which analyses the evolving role of academic institutions in innovation systems and development in a variety of countries ranging from Germany, Sweden and Denmark to Latvia, Russia, China, Vietnam, Uruguay, Brazil, Cuba, South Africa and Tanzania).

3 TECHNOLOGY TRANSFER AND TECHNOLOGICAL CAPABILITIES

3.1 Technology transfer

Technology can be defined in a narrow or broad way. A narrow version simply refers to the technical information that is attached to a certain technology, i.e. information that is codifiable and accessible through written information, for example documents. This definition is associated with the hardware of production. A much broader definition of technology is defined by Frances Stewart (1977) in the following way:

> *"All skills, knowledge and procedures required for making, using and doing useful things. Technology, therefore, includes the software of production – managerial and marketing skills, and extended to services- administration, health, education and finance." (Stewart, 1977).*

This complexity in which technology can be defined also applies to the transfer of technology. It is important to be aware of technology transfer as far more complex than simply moving technology from one place to another. The capacity to understand and develop new technology is crucial (e.g. Komoda, 1986). "Technology transfer is not just acquiring of knowledge in production, but also a building of the nation's technological capability" (Chen, 1996: 182). According to Chen, the difficulties in defining technology transfer stem from the insights that "technology is knowledge, not a product" (ibid. 82). Consequently, there are many aspects in the transfer process that need to be considered and a number of potential "barriers" to overcome.

In order for technology transfer to actually be effective and successful, the capabilities of the recipient organization as well as the infrastructure of the wider local context are important. They both impact the extent to which technology can be transferred, further developed and adopted to specific local needs and use.

Broadly defined, technology transfer is "an effective mechanism to advance the flow of technological development in a developing country's economy" (Kumar et al., 2007). Technology can be marketed in different

ways, either as a complete entity or in fragmented ways, meaning that the technological parcel is divided in separate pieces. A number of different factors influence the process of technology import, such as the technological market, the parties to interact with during the process and the contract. It appears that those who buy the technology are often in a weaker bargaining position during these transactions, and by avoiding mechanisms such as supplier financing, their power may be increased (Abdelkader, 1988).

The following figure illustrates critical elements that are important for successful technology transfer. It shows the complexity of this process and the large range of different factors that have an impact on the success of the transfer. It is based on the analysis of technology transfer processes in the formal economy. The extent to which the framework is useful to understand technology transfer to informal firms will be discussed throughout the thesis.

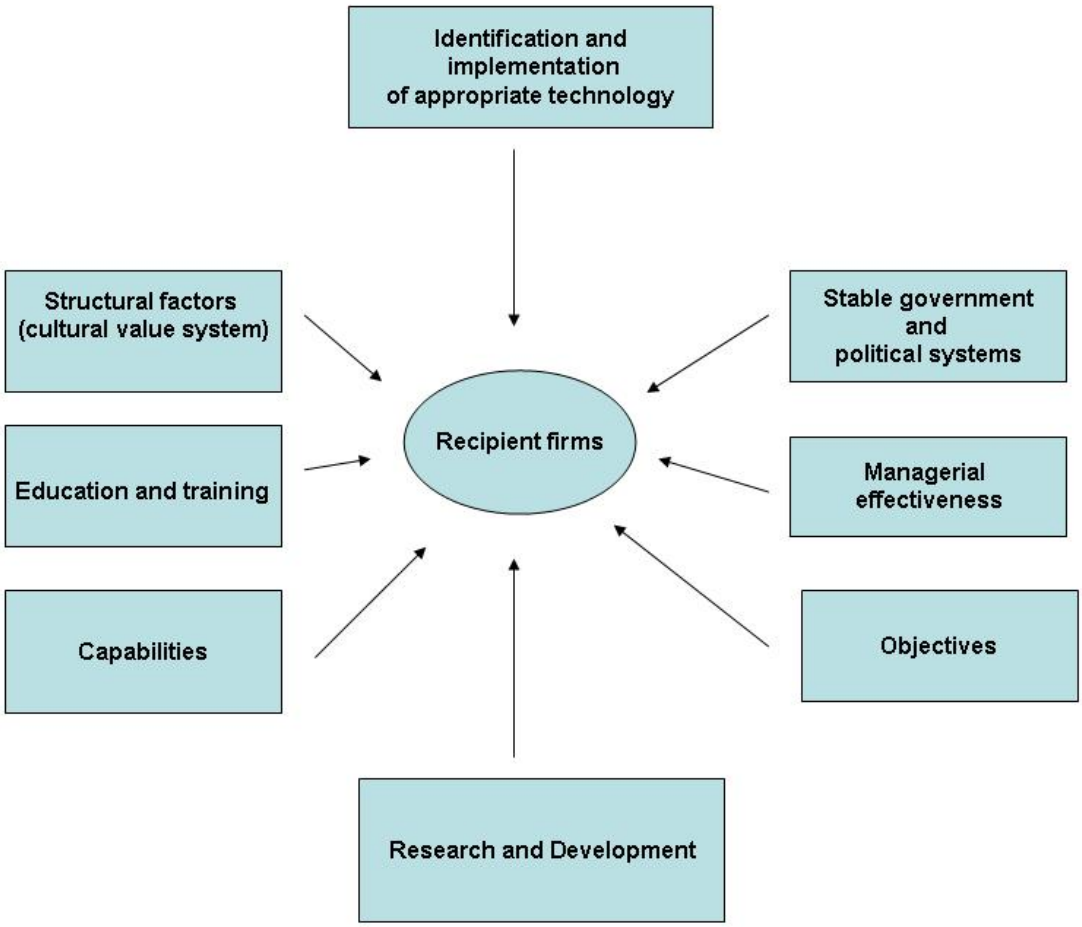

Figure 1: Critical factors for successful technology transfer
Source: adopted from Madu (1989: 120)

As the figure illustrates, there are a number of factors that need to be in place in order for the technology transfer to be successful. In the above model, there are structural factors, education and training and capabilities that impact on the success of the transfer as one block. A stable government, managerial effectiveness and objectives form another. The two remaining impacting factors are R&D and the identification and implementation of appropriate technology.

To an LDC, the *appropriateness of technology* may form the most important aspect in the technology transfer and the aspect has been much debated (Stewart, 1977; Komoda, 1986). The technology can be poorly suited to the local production needs (Prasad, 1986), and the ability to identify the

right technology hence becomes crucial (Ladman, 1977). The *objectives* refer to the identification of specific problems and needs which lead to the formulation of objectives for the technology transfer. *Capabilities* here refer to the human resources, capital, natural resources and land resources. *Education and training* capture the need to train employees of the recipient firm. In this connection it has been suggested to train employees of LDCs in the West, for instance in productivity improvement, and to include industrial exposure in the training (Adler, 1986). Further, the training has significant impact on the ability of the recipient to improve and modify the transferred technology. In order to perform improvements and modifications, the recipient needs to be capable of maintaining an introduced production system (Ito, 1986). Importantly, failures of technology transfer due to insufficiently trained personnel have been noted (e.g. Maier, 1986; Alarez, et al., 1985). In all these efforts of e.g. training, the *value system* of the country should be given attention to identify appropriate training, taking potential barriers of language and culture explicitly into account. *R&D* is highly important for a successful technology transfer and links to similar issues as for education and training; it enables further creative modification of the technology (e.g. Crawford, 1987 a and b). The *managerial effectiveness* incorporates the ability of managers to be responsive to the environment as well as committed to the newly transferred technology. It is essential that managers in developing countries have knowledge about organizational behaviour as well as the dynamics of organizations (Rodrigues, 1985). Wallender (1979) argues that the ability to plan, identify and solve problems needs to be developed by developing country managers. The management process is a highly important element in the technology transfer and refers both to the management of production processes, of capital and of human resources. *Stable government and political systems* refer to the whole set of public policies that affect the transfer of technology and the impact that governments can have on promoting or constraining the process of technology transfer.

A critical question in this dissertation is to discuss how technology transfer can occur within a LDC (as opposed to being transferred from the West to an LDC) when all of the conditions described before are not existent. In the informal economy, we are dealing with informal firms in which capabilities are low, the educational level is low, managerial skills

are basically absent and there is no stable socio-economic and political system. Thus, those factors that have been identified as crucial enablers and supporters for successful technology transfer are basically absent in the context of most LDCs.

Much of the literature on the impact of technology transfer on host countries investigates the appropriateness of the technology that is being transferred. Externalities, for example through spillovers to the local industry to which the technology has been transferred or other industries or even the economy as a whole, are very important in this respect.

There are, for instance, technical (referring to the technical risks, operational test data and risk aversion), regulatory (specific restrictions on technology, development and procurement lead times, intellectual property rights, lack of funding) and people barriers (lack of trust, lack of communication, experience with transfer, unawareness of new technologies, lack of information) (Greiner and Franza, 2003).

Different mechanisms or "bridges" to overcome or reduce these barriers exist, such as the measurement of the effectiveness of the transfer, proactive communication, documentation of existing methods, linking developers and user reward mechanisms, etc. (ibid). Only if various hinders are holistically addressed and the technology is viewed in its complex, entire context, the transfer will contribute to the social and economic development of industries in the increasingly global marketplace (e.g. Combs, 1999; Kultti and Takalo, 2002; Urs et al., 2004).

If the technology transfer process is successfully implemented, it would also lead to an increase in the technological capability of the organization and country to which it was transferred. Hence, the traditional focus of technology transfer was to view it as a process that leads to the acquisition of new technology from one firm to another to improve the technological competence of the receiving firm and increase its internal technological capability. In recent years, concerns have increasingly shifted to research of universities as a crucial source of new technological knowledge and products that have been transferred and contributed to innovations in a number of fields (Abramson, et al., 1997; Geiger and Sa, 2005; Hershberg et al., 2007; Mansfield, 1998; Bramwell and Wolfe, 2008; Ventriss and Gurdon, 2006).

We can still adopt the figure (see figure 2) developed by Bell (1987) to capture the different technological transfer processes that take place between two organizations, according to the form of knowledge flow. While he investigated the flow of knowledge between the exporting firm and the importing firm, his framework is here adapted to the transfer of technology between university and firms.

The first flow (flow A) consists of technological services and capital goods. Flow A is an element of many investment projects with respect to purchase of equipment and machinery. This acquired hardware is then incorporated into, for instance, new facilities for production and is thus part of the increase in the production capacity. Flow A does neither enable the recipient of the technology to effectively use the facilities nor does it generate technical change on its own.

Flow B of the technological content in the transfer process consists of the operating skills needed for the production activities, including service, maintenance and repair, as well as the skills needed to run the new facilities. It also consists of know-how. The technology transferor is here taking a different role than in flow A and is actively teaching the recipient the relevant tacit knowledge. In addition to the expertise provided by the transferor, new knowledge may also be acquired from within the production facility as a result of training and learning processes in-house with the new hardware. Thus, flow B has a strong element of using and transferring the human resources of the transferor and requires a high effort by the staff of the importing firm to internalize the set of skills that is needed. It is crucial to stress here that simply acquiring new machinery does not automatically lead to the increase in corresponding and required technological capabilities. Therefore, flow B does not transfer the elements incorporated in a successful transfer which are needed to enable the recipient to generate technical change on its own.

This – the knowledge and expertise needed for the generation of technical change - is included in the technological content that is transferred in flow C; through this flow, the firm is able to creatively further develop the production facilities. This could include changes in the production process, in the procedures, in product design, but also changes in the organizational structure in the post investment phase of

the project (this set of capabilities that is potentially acquired in flow C refers to the advanced capabilities that are specified by Lall (1992) (see also table 4), and that forms part of the group of the technological capabilities applied in this thesis.

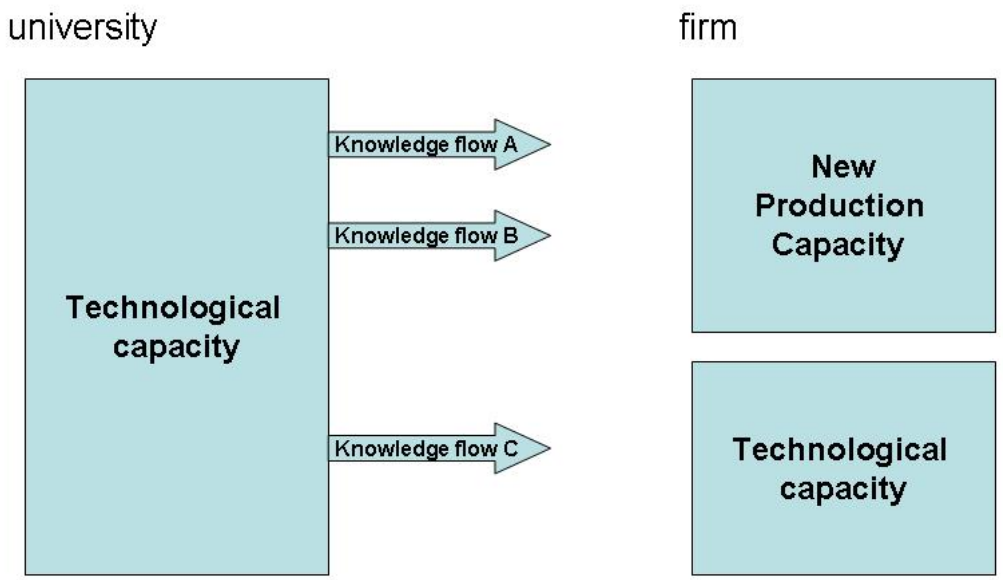

Figure 2: Technological transfer process

Source: Adapted from Bell, M. (1987: 14).

Figures 1 and 2 are complementary. While the former refers mainly to the determinants of the successful technology transfer, the latter focuses on the different technological content incorporated in different flows of knowledge. Both figures will be used in this thesis.

3.2 University technology transfer

The issue of technology transfer from university to industry has been on the agenda of academics and practitioners since the mid 1980s in connection with several changes, among others the rise in venture capital and the Bayh-Dole Act (the provision of incentives for universities to patent their scientific discoveries which is supported with federal funding) in the US and its facilitating function of interactions between university and industry. Public and private universities started to establish technology transfer offices in their organization and started spin-offs (the founding of new firms) and commercialization of university research through licensing. As a result of these changes, it is argued that universities particularly in developed countries have become increasingly entrepreneurial (Mowery et al., 2004; Siegel, 2006a); a global perspective is emerging (e.g. Etzkowitz and Zhou, 2008; Leong et al., 2008; Etzkowitz et al., 2008).

At the core of the entrepreneurial university concept is the role of the university as a source of technology and knowledge directly applicable in industry (e.g. Etzkowitz, 1998). And, as such, it is a rather contested concept (Brundenius et al., 2009).

While research on university entrepreneurship is prospering, it continues to be a rather patchy field that encompasses different sub-fields such as technology transfer, the study of university licensing, of science parks, incubators, spin-offs, etc. Rothaermel et al. (2007) identified 173 articles on the topics entrepreneurial research university, productivity of technology transfer offices, new firm creation and environmental context, including networks of innovation. Their review showed that 45% of the studies covered in the 173 articles were performed outside the US. These international studies are mainly done in Europe, predominantly in the UK and Sweden, very few studies are performed in developing countries. Although it cannot be strictly classified as a study of the entrepreneurial university, the UniDev project investigated the evolving role of academic institutions in innovation systems and development (UniDEV) in a large number of developing countries (Göransson et al., 2009; Göransson and Brundenius *forthcoming 2010*), paying attention to the linkages with industry. This was also done in a

project on university–firm interactions in Sub-Saharan Africa conducted by the South African Human Sciences Research Council (HSRC) (Kruss et al., 2009).

Studies in the field of the entrepreneurial university have recognized that external factors are influencing the process of university entrepreneurship (Etzkowitz, 2003). This can be through laws and policies such as the Bayh-Dole Act in the US and cultural and historical context (Mowery et al., 2001; Jacob et al., 2003), through the nearby industry (Gulbrandsen and Smedby, 2005) or regional conditions (Friedman and Silberman, 2003). An overall characteristic is that universities are expected to be less autonomous as has traditionally been the case, and they are more responsive to meet the societal demands and demands of integrating into the global knowledge based economies (Clark, 1998, 2003, 2004; Newsman et al., 2004; Audretsch and Phillips, 2006; Gregersen et al. 2009; Jacob and Hellström, 2000).

In this endeavor, a key focus has become the promotion of university-industry linkages. Universities have therefore been concerned with the implementation of a range of incentives and have created various mechanisms for the transfer of technology (such as science parks, incubators, spin-off, etc.) (Debackere and Veugelers, 2005).

Important questions that have been addressed in this emerging and still fragmented field are why some universities are more successful as regards their technology transfer to industry than others (e.g. Harmon et al., 1997; Henrekson and Rosenberg, 2001; Etzkowitz, 2003; Friedman and Silberman, 2003; Jacob et al., 2003; Siegel et al., 2004), what barriers exist for universities to become closer to industry (Collins and Wakoh, 2000; Feldman and Desrochers, 2003; Schmiemann and Durvy, 2003; Siegel et al., 2004; Mowery and Sampat, 2005), how the success in entrepreneurial activities can be increased (Friedman and Silberman, 2003; Owen-Smith and Powell, 2003) and how entrepreneurial universities can take needs outside the ivory tower into account and relate to this in a better way (Segal, 1986; Bell, 1993; Mansfield, 1995; Hall et al., 2001; Gulbrandsen and Smeby, 2005; Mowery et al., 2001, Moray and Clarysee, 2005).

Thus, while technology transfer features implicitly and explicitly in all these questions, the recipient - or participant in a two-way technology and knowledge exchange - is very much treated like a black box, and the main focus is instead on the transferor (i.e. the university). Consequently, the conditions and existing capabilities of the recipient are very much neglected as are the impact of the transfer process on the capabilities.

When dealing with the issue of university technology transfer in LDCs, it is also extremely crucial to bear in mind that the conditions of these universities are very different from those in developed countries as are the conditions of the firms (e.g. Sagasti, 2004). However, despite of these different conditions and contexts, evidence suggests that governments in LDCs are increasingly borrowing and applying policies, incentives and programmes for the promotion of linkages between universities and industry and the transfer of technology from developed countries (Diyamett, 2008; Kruss and Petersen, 2009).

Only little systematic analysis exists of the situation of universities in their changing role (Mwamila and Diyamett, 2009; Ndabeni and Maharajh, 2009; Kruss, 2005, 2006; Mwantima, 2008) and even less focus on the characteristics of the firms that are engaging in interactions with universities in LDCs in general and in Africa in particular. In the South African context, it has been proposed to place the firms at the center of analysis to overcome a gap in the present understanding of university and firm interaction (Kruss, 2007; Lorentzen 2009b).

In particular, the contribution of this thesis is its focus on the linkage between the formal and the informal economy as the firms that receive the technological knowledge from the university are all informal. This further differentiates the present work from the abovementioned recent contributions as the matter has not yet been studied within this emerging field of research. Informality is a crucial feature of firms in Sub-Saharan Africa.

In the case study in this thesis, the transfer of technology takes place between CoET and the selected informal enterprises belonging to Sengerema Gatsby Club. More specifically, it is between a university college and informal enterprises belonging to the Gatsby Club in the Sengerema district. The question to be investigated is how this

technology transfer takes place, meaning through what mechanisms and what types of knowledge flows are embedded in the different mechanisms.

There are a number of different mechanisms that can be applied in the transfer of technology between university and industry, depending on the resources that are available and the overall aim and motivation for the transfer. These can be conferences, publications, consultancy and technical service provision, joint venture of R&D, seminars, cooperative R&D agreements, licensing, patenting, contract research, science park, research park, technology park, incubators, spin-offs and training.

Two broad categories can be distinguished in these mechanisms, depending on the type of interaction with industry. There is the two-way technology flow with the aim to endorse technology and knowledge transfer between industry and the university. This type of transfer includes involvement of industry in the R&D activities of the university. In this type of two-way transfer the costs and facilities of the R&D are also shared (Lee and Win, 2004). The other type of transfer is one-way only and supports the transfer from university to industry (or from industry to university, but never both ways simultaneously with mutual learning and exchange of technology and knowledge). In this one-way technology transfer, the costs are entirely covered by the university.

Two-way technology flow mechanisms are conferences, cooperative R&D agreements, science, research and technology parks, training and seminars (both training and seminars could also be only one way, depending on the feedback provided by the participants). Typical one-way technology flows are licensing, patenting, contract research and spin-offs.

Both types of mechanisms will be investigated in this thesis.

The impact of technology transfer can be assessed at the national level, regional level, local and firm level. The assessment of the impact of the technology transfer from the university to informal firms is the one that is dealt with in this thesis. The next section therefore discusses firm level capabilities.

3.3 Technological capabilities

In the evolutionary theory of the firm, it has been argued that the firm is a repository of knowledge (Nelson and Winter, 1982) and this knowledge exists in the organizational capabilities of the firms, which then determine the performance of the firm. In this thesis, the concept of technological capabilities is used, but related concepts are briefly reviewed in the following.

The capabilities addressed in the evolutionary theory of the firm are routines, routinized patterns of behavior which in turn are products of organizational learning and knowledge (Nelson and Winter, 1982). Organizational learning has been characterized as a social and collective phenomenon (Teece and Pisano, 1994) which involves joint problem solving and coordinated "search". Moreover, organizational learning is cumulative and path-dependent in nature. What has been learned is stored in routines and expressed in the firms' capabilities.

The "dynamic capabilities" approach (Teece et al. 1997) refers to capabilities within the firm which allow the firm to create new products and processes and to be in a position to respond to changing market environments. With the term "dynamic" is referred to "the capacity to renew competences so as to achieve congruence with the changing business environment" (Teece, et al., 1997: 515).

An example of a dynamic capability is strategic decision making ("in which managers pool their various business, functional and personal expertise to make the choices that shape the major strategic moves of the firm" (Eisenhardt and Martin, 2000: 1107)). Other dynamic capabilities focus on for instance "reconfiguration of resources within firms", as well as "transfer processes, including routines for replication, and brokering are used by managers to copy, transfer and recombine resources, especially knowledge-based ones, within the firm" (ibid).

Technological competence is a set of dynamic resources, including skills, knowledge and routines, which are needed to generate and manage technological change, involving production activities, investment activities or the linkages with other firms (Bell and Pavitt, 1995). Related to this, Kim (1980) introduced the concept of "technological capability"

which he in a later work defined as "the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt and change existing technologies" (Kim, 1997: 4).

Following the definition outlined above, technological capabilities are the result of interactive learning and linkages between a number of actors. Although the literature on innovation in developing countries has referred to the need to build the capacity to absorb on a national level, the fact is that it is a function of the individual firm's absorptive capacity and their interrelation with other actors in the system. LDCs need to develop these skills, knowledge and institutions connected with organizational and managerial structures in order to build well functioning IS and to grow efficiently.

Hence, the TC approach focuses on the ability to use available resources and competence. Interactions with other actors play a crucial role in this. Moreover, upgrading is only positively related to economic growth and development in countries where a minimum level of absorptive capacity is available, i.e. "the ability to search and select the most appropriate technology to be assimilated from existing ones available, as well as the activities associated with creating new knowledge" (Narula, 2004: 6). At firm level, absorptive capacity is defined as the firm's ability to identify, assimilate and exploit knowledge external to the firm, i.e. from its environment (Cohen and Levinthal, 1989, 1990) which, in turn, is directly related to the ability to produce new technologies.

Importantly, in this approach, technology is not purely viewed as technological means (its hardware and equipment, etc.), but instead it highlights the technological information (e.g. instructions) and understanding (the tacit elements) required to effectively use the technology acquired. Thus, it incorporates the technical, managerial and organizational skills that are needed at the firm level for the efficient use of technology and accomplishment of processes of technological change.

This understanding of technological capabilities has implications on the way knowledge and technology can be transferred. For instance, tacit knowledge is much more difficult to transfer as it is person embodied and embedded in a specific context. Hence, in contrast to a physical product, technology cannot be easily transferred to a firm or a

developing country without the transfer of other technological knowledge. In order for technology to be implemented effectively, essential elements of capability building need to be considered. Thus, the mere provision of equipment, of operation instructions, designs or patents will not guarantee the effective use of the technology without adequate capabilities available at the recipient organisation.

Broadly understood, technological capabilities are therefore crucial in order to effectively use technologies that have been developed elsewhere (i.e. other countries or other organizations) as well as to be able to adapt, improve and create new, own technologies (e.g. Lall, 1992; Lall, 1993; Bell and Pavitt, 1993, 1995; Kim and Dahlman, 1999; Dutrenit, 2004; Padilla-Perez, 2006; Iammarino et al., 2008). The technological capabilities approach therefore highlights the very crucial role of technological learning.

Following Lall, it is possible to classify the TC according to the different functions that the technological capabilities perform as well as the degree of their complexity (i.e. different levels ranging from basic via intermediate to advanced) (based on Lall, 1992 and 2001)[14]. As regards the functions, Lall differentiates between investment, production and linkage capabilities.

Investment capabilities refer to skills needed before an investment is made. This includes the capabilities to assess the feasibility and profitability of a project, define specifications, what technology is required, negotiations of the purchase, recruit and train skilled personnel and design the basic process and supply the equipment.

Production capabilities refer to the skills that are necessary to efficiently operate a plant with a given technology and the improvement of the technology over time. This includes for instance process, product and engineering capabilities.

While investment and production capabilities have been specified as primary activities (Bell and Pavitt, 1995), *linkage capabilities* are grouped as

14 Other categorisations have been proposed by Dahlman and Westphal 1982, Dahlman et al., 1987 and Katz, 1987.

supporting activities and refer to the ability to link up with other actors in the economy.

Thus, in his 1992 paper, Lall kept the functional categories as key columns in the framework (see table 1 below), but with somewhat changed or differently arranged categories (as compared to his 1987 book). Furthermore, the levels of capabilities are identified very clearly in the rows that cut across all the different functions. The rows are ordered according to their degree of complexity and are associated with specific types of activities such as adaptive, duplicative or innovative. He further distinguished between stages. The investment stage includes the functions of preinvestment and project execution, and the production stage includes the functions process engineering, product engineering, industrial engineering and linkages with the economy.

Despite of the fact that this scheme by Lall clearly addressed the idea of separating different capability levels, two difficulties still remained. One difficulty relates to the basic level component which also included, even if very modest, aspects of creative activity while in some developing country contexts of an entirely non-creative use of certain technologies had been identified (UNCTAD, 2007). Another problem relates to the distinction of project cycles in two stages (investment and production stage) as some of the functions are potentially relevant in both stages and not only one. This is particularly relevant for process and project engineering that can be crucial functional activities in both phases (ibid).

Table 1: Technological capability matrix

		Investment		Production			
		Preinvestment	Project Execution	Process Engineering	Product Engineering	Industrial Engineering	Linkages within Economy
Basic level	Simple, routine (experience based)	Prefeasibility and feasibility studies, site selection, scheduling of investment	Civil construction, ancillary services, equipment erection, commissioning	Debugging, balancing, quality control preventive maintenance, assimilation of process technology	Assimilation of product design, minor adaptation to market needs	Work flow, scheduling, time–motion studies, inventory control	Local procurement of goods and services, information exchange with suppliers
Intermediate level	Adaptive, duplicative (search based) terms;	Search for technology source, negotiation of contracts, bargaining suitable terms, information systems	Equipment procurement, detailed engineering, training and recruitment of skilled personnel	Equipment stretching, process adaptation and cost-saving, licensing new technology	Product quality improvement, licensing and assimilating new imported product technology	Monitoring productivity, improved coordination	Technology transfer of local suppliers, coordinated design, S&T links
Advanced level	Innovative, risky (research based)		Basic process design, equipment design and supply	In-house process innovation, basic research	In-house product innovation, basic research		Turnkey capability, cooperating R&D, licensing own technology to others

Source: Lall, 1992

While this classification is extremely useful to understand upgrading in firms, its application to other developing country contexts is arguable. The types of categorizations that are made are derived from studies in the formal economy. How this classification can be adapted to the informal economy will be discussed both in the analytical framework as well as in the result of the empirical analysis of the thesis.

3.4 The informal economy and informal firms

In the context of this research, it appears extremely important to understand how economic activities are organized in the informal economy, as it comprises by far the largest sector for income and employment in many developing countries, also Tanzania.

In an underdeveloped context, there is a huge extent of economic activities that are "unmeasured, unrecorded and, in varying degrees, illegal" (Barrat Brown, 1995: 217). Thus, in a very generalized way, all the economic activities that are behind any state control, unregistered and unregulated, belong to the informal economy. Importantly, it is not confined to specific sectors only – as the earlier and sometimes interchangeably used term "informal sector" might confusingly indicate. Hence, the informal economy is cutting across a large range of entirely different sectors.

The informal economy is dominated by individual entrepreneurs, family enterprises or small groups who may organize themselves together with the overall aim of joint production and to sell their products and services. These activities range from – to mention a few - vehicle repair, woodworking, hand crafts, paintings, clothing, shoe manufacture, construction, growing and selling vegetables and fruits.

Three main schools of thought deal with the relationship between informal and formal economies (Chen, 2002):

The dualist school views the informal economy as a marginal economy separated from the formal economy. It generates income and a safety net for poor people (ILO 1972). The structuralist school views the informal economy as hierarchically subordinated. Producers and traders are

subordinated by capitalists who seek to reduce costs (Castells and Porters, 1989). In the legalist view, informal economic activities and workers are a direct response to bureaucracies and overregulation by governments.

Following the dualist view, when the informal economy was "discovered" during the 1970s, it was believed that this was a temporary phenomenon which would basically disappear once a more modern industrial development would take place, and sufficient economic growth would be registered (Chen, 2002). More specifically, it was assumed – based on a theoretical model of economic development developed by W. Arthur Lewis during the mid 1950s - which the supply of labour in developing countries had no limits and therefore this surplus of labour would flow into the modern sectors once they would have grown.

However, this theory was rapidly abandoned after the first International Labour Organisation (ILO) employment mission went to Kenya and documented that the informal sector, far from diminishing, had further grown with the industrialization of the country. Moreover, it was found that also profitable enterprises belonged to the informal economy which led to a change in thinking that gave birth to the structuralist view. Critical reactions to these findings were arguments that the economic growth in countries like Kenya had not been sufficient enough in order to effectively absorb the surplus of workers. It was also assumed that since the informal economy was considered as marginal, it had no linkages whatsoever to the formal economy – something that did not match with a more complex reality later on.

The provided explanations for the constant growth of the informal economy as well as the difficulties to formalize the informality are diverse, although the main ones relate to the legalist view: the limited absorption of labour into the formal economy and the many barriers that hinder or challenge a gradual transformation of informal economic activities into formal activities. These are extremely high costs, and strict regulations along with corruption in connection with business permit granting and start-ups of businesses which force micro-entrepreneurs to stay informal. Other reasons are weak institutions, ranging from for example inadequate education and training possibilities to lack of adequate incentives and protection, which again partly goes back to the

cost arguments. The informal economy has also partly boomed as a result of demand for low cost products and services (De Soto, 2000; ILD, 2005; FIAS 2006; ILO, 1991; ILO, UNIDO and UNDP, 2002; World Bank, 2006)[15].

To sum up, specific characteristics of the informal versus formal sector are presented in the following table:

Table 2: Informal versus formal sector characteristics

Informal sector	Formal sector
Ease of entry	Difficult entry
Reliance on indigenous resources	Frequent reliance on overseas resources
Family ownership of enterprise	Corporate ownership
Small scale operation	Large scale operation
Labour-intensive methods of production and adapted technology	Capital-intensive and often imported technology
Skills acquired outside the formal school system	Formally acquired skills, often expatriate
Unregulated and competitive markets	Protected markets (through tariffs, quotas and trade licenses)

Source: ILO, 1972

Despite the particularities of the informal economy in different countries (Amin, 2002)[16], almost all definitions refer to and capture economic activities that are not reported in publicly available GDP statistics. Hence, all of them are operating outside the legal state system with its

15 For example, the number of procedures for starting a business in Tanzania is 13 (and 11 in Kenya and 17 in Uganda as the east African neighbours), while it is only 3 in Sweden (and 4 in Denmark). The estimated time that this takes is 35 days in Tanzania versus 16 in Sweden. The costs are 557 USD in Tanzania as opposed to 190 USD in Sweden.

16 Due to the heterogeneity of the informal economies in various countries, there are many more concrete definitions of what this phenomenon refers to. These range from labor categories to industrial classification, urban spatial structure. Proper business versus home based enterprise, size (number of employees), migratory status, rural/urban divide, quality of employment to potential to enhance income/employment.

particular regulations. A crucial consequence of this is the very limited access to new technologies and extremely little opportunity to receive any funds or loans.

Despite of these characteristics and despite of the fact that for example many enterprises are not formally registered, a majority of the activities that take place in the informal economy result in products and services that are produced and distributed in a legal way, indicating the complex intertwining of formal and informal spheres. It is therefore crucial not to mix the informal economy with the criminal economy (Flodman Becker, 2004: 11). To clarify this, in the informal economy, activities are usually not performed with the explicit intention of evading tax payment or contributions to the social security system or the infringement of labor legislation. However, restricted illegal and legal operations or operators are included.

Accurate estimates of the exact percentage of population involved in informal activities are difficult as there are full time employees in the informal economy, but also persons working in the formal economy with extra jobs in the informal economy.

As regards informal enterprises – which are the main focus in this dissertation – the international definition[17] makes a distinction between two specific sub- categories of informal economy enterprises:

Family enterprises that are comprised of independent and own–account workers, family workers, apprentices and workers, and with no permanent employees

Micro-enterprises comprised of units with less than 5 to 10 employees (or jobs), and which are not registered as enterprises.

The focus of the definition is here on the production unit, derived from 1993 definition by the International Conference of Labour Statistics (ICLS). These units operate mostly at a low level of organization, and a typical characteristic is that there is limited or no division between labor

17 www.worldbank.org (Urban Development, Program and Project Options, What is the informal economy, 2003-10-10).

and capital as factors of production. In the cases where labour relations exist, they are usually based on casual employment, kinship or personal relations instead of contractual arrangements that include formal guarantees from both parts.

Informal enterprises interact with other organizations of the economy in a limited manner. For example, due to lack of information about the benefits that could accrue to them through usage, the informal sector tends to have lower demands for non-financial services such as research and development (R&D) activities, training and consultancy which could assist them in addressing problems of high production cost, poor human resource management, poor quality of products, poor packaging, identifications of alternative materials and/or processes. Furthermore, they tend to have limited associations with sources of knowledge belonging to the formal economy, like universities. How to transfer knowledge to this important part of the economy remains a challenge.

It is crucial to emphasize that the informal economy is dominated by small entrepreneurs and that there are many instances of local innovations. Thus, informality does not imply the lack of an entrepreneurial spirit. A rich and interesting description is for instance the one by Bertelsen and Müller (2003) on village blacksmiths and indigenous boat building in Tanzania where they demonstrate how exogenous technological inputs are feeding into innovative transformations. The motivation of their research lies precisely in the recognition that in Tanzania, an increasing number of people are involved in producing and exchanging goods and services in the informal economy, with technologies that are regarded as low and simple as opposed to those that are seen as high and advanced in the formal economy. One of Bertelsen and Müller's key findings is that the indigenous innovation system is difficult to explicate since it is operating under informal institutional settings, with different rules than those in the formal economy.

Possibilities for development and growth are mostly assumed to occur as a result of a restructuring of existing economic activities, though rationalising the existing activities and policies. Upgrading skills and capabilities in the informal economy is a challenging task, and the models implemented so far have not been successfull. The collaboration with

local sources of knowledge may be an interesting alternative approach to the models inspired from industrialized countries (as e.g. structural adjustment programmes and refining policies to attract more FDI), allowing for the restructuring of economic activities from within, as proposed in Giri's (1995) model of rising up the ladder of formality.

Giri (1995) introduces a "trialist model" with respect to African economies in which he differentiates between three different levels. This model consists of first the modern sector compiled of large enterprises (state, foreign or jointly owned) and additionally some private African medium sized enterprises. Second, there is an "intermediate" sector of small enterprises and a few medium sized with little capital but all locally owned. The third level is comprised of the so-called informal economy, which is the subsistence sector and consists primarily of households and one-person enterprises. On this level, there is almost no capital available, and the activities are wholly informal (ibid 219-220).

This model draws attention to the fact that economic activities are organized in different spheres and with skills for these activities placed in these very different "levels". These differences constitute the context in which technology transfer and technological capability building take place in this thesis, from the formal to the informal (i.e. spanning over different spheres), and this is different from the studies in this field performed in developed countries.

3.5 Research gap

This thesis focuses on technology transfer between a university and informal firms. As the review of the literature has shown, innovation is crucial for development. Innovation is based on interactive learning. An important form of interactive learning is through technology transfer taking place in a university – industry linkage. The technology transfer literature provides a framework to understand how this transfer of knowledge from a university to firms takes place.

However:

a) This framework has been developed in the context of developed countries and the formal economy

b) It is vague at the level of firms' impact and how they accumulate capabilities.

Hence, this thesis aims to contribute to this research gap by investigating how technology can be transferred between a university and informal firms in an LDC context. A crucial question in this concern is what type of technological capabilities have been acquired by informal SMEs as a result of interaction with the university and how these technological capabilities have been acquired.

It should be stressed again that it is very difficult to access any data about informal business activities in Tanzania as firm specific data is basically non-existent, and in almost all cases not available for the public. Nevertheless, the Tanzanian economy is clearly dominated by the informal economy and therefore it is extremely important to understand dynamics of technological capability building in this context, not least as the innovative potential and the entrepreneurial spirit in this sector exists and should be further uncovered (see e.g. Bertelsen and Müller, 2003).

4 ANALYTICAL FRAMEWORK

The analytical framework developed in this chapter is applied to study technology transfer and the dynamics of technological learning and upgrading at the informal micro level in an East African setting. It does so by integrating concepts from different fields of study, the main components taken from technology transfer and technological capability building literature.

This chapter therefore draws on the literature that was synthesized in the previous three chapters and provides a set of categories to analyze a) technology transfer mechanisms, b) technological capabilities and c) how they were acquired in the collaboration between UDSM/TGT and indigenous, informal SMEs.

4.1 The technology transfer mechanisms

In the context of this thesis, a set of specific technology transfer mechanisms implemented in the TGT-CoET collaboration has been identified.

In each of these mechanisms (student projects, incubator program and Gatsby Club creation), it is analyzed what type of knowledge is transferred, according to the different flows of knowledge, as explained in the previous chapter.

Thus, Bell's (1987) distinction between knowledge flows A, B and C is used to analyse how technology is transferred in the three different mechanisms.

In addition to the specific technological content in these knowledge flows in the three mechanisms, the levels and types of technological capabilities that were acquired through the Gatsby Club mechanism were analyzed as described in the next section.

4.2 The levels and types of technological capabilities

A set of specific firm-level technological capabilities adopted from Lall (1992), Bell and Pavitt (1995) and Ariffin and Figueiredo (2003) has been applied for the survey and analysis in this dissertation[18]. The technological capabilities are categorized into different levels: basic, intermediate and advanced, and they are also distinguished between process and product technological capabilities. Furthermore, the categories of investment, production and linkage capabilities are used. Thus, the classification used is, as summed up below, divided into levels and types.

CLASSIFICATION OF TCs:

- Levels
  - Basic
  - Intermediate
  - Advanced
- Types
  - Investment capabilities
  - Production capabilities
  - Linkages capabilities

The analysis of the empirical material in this thesis examines how capabilities of these different levels and types have been acquired by the informal firms and discusses how suitable this categorization is for informal firms in Tanzania.

The specific activities belonging to the different levels of technological capabilities that have been derived from the literature are systematically presented below, starting with the basic capabilities and ending with advanced capabilities. While they have been carefully chosen for the survey to best suit the context, the empirical results showed surprising

18 I have tried to include those that appeared relevant to LDCs and left out others that based on the sectors and country did not appear relevant.

different results for some categories and answers as discussed in chapters eight and nine.

4.2.1 Basic technological capabilities

The technological capabilities that were specified in the survey for the basic level in **processes** were:

1) The assembly of components and final goods

2) The introduction of minor changes to process technology to adopt it to local conditions

3) Maintenance of machinery and equipment

4) Introduction of planning and control of production and

5) Improvement of efficiency in existing work tasks.

For **product** technologies the following activities belong to the level of basic technological capabilities:

1) Replication of fixed specification and design

2) Introduction of minor adaptations to product technology (driven by market needs) and

3) The conduction of routine quality control to maintain standards and specifications.

4.2.2 Intermediate technological capabilities

To capture the acquisition or improvement of intermediate technological capabilities, the firms were asked if they were performing the following activities:

1) Manufacture components

2) Improvement of layout

3) Introduction of automation of processes

4) Selection of technology

5) Reception of an international certification.

The following **product technological capabilities** were considered intermediate:

1) The introduction of new design for manufacturing

2) Development of new prototypes

3) The improvement of product quality.

4.2.3 Advanced technological capabilities

The activities belonging to advanced technological capabilities for **process technological capabilities** are:

1) Performance of own-design manufacturing
2) Introduction of major improvements to machinery
3) Development of new equipment
4) Development of new production processes
5) Introduction of radical innovations in the organization.

For **product technological capabilities** the activities are the following:

1) Development of entirely new products or components
2) R&D into new product generations
3) Research into new materials and new specifications.

4.3 Acquisition of new knowledge

A further category deals with an assessment of the impact of the technology transfer mechanisms on external linkages of the recipient firm, i.e. whether and what type of new knowledge sources firms were using as a result of the transfer process. Firms were also asked to specify in general what type of actors they collaborate with and for what purpose (e.g. whether they received technical assistance, learned new managerial techniques).

5 DATA AND METHODOLOGY

This chapter gives a general account of relevant methodological issues and explains the choice of method used for the research in this dissertation. It thus presents the overall research design of the thesis, including the sampling, case selection, data sources, collection and interpretation of the data. The concrete processes in the collection and analysis of the data are described. The chapter ends with a discussion of reliability and validity.

In light of the complex research issues and scarcity of any available material from LDCs dealing with technology transfer to informal enterprises, a combination of qualitative and quantitative methods appeared the most appropriate and suitable strategy for the research. Apart from the usual method choices, conducting fieldwork and gathering data in a LDC context poses a number of challenges that are elaborated in the following section to some extent.

5.1 Basic methodological choices

The first fundamental choice of method in almost any research project is that between a qualitative and quantitative approach. When considering alternatives in the overall research design and the method choices to be made, the relative strengths as well as weaknesses of qualitative or quantitative data are crucial. As Albert Einstein stated "Not everything that can be counted counts, and not everything that counts can be counted" (cited in Patton, 2002: 12), which perfectly captures the essence of implications of the method choices.

Whether a qualitative or quantitative approach is more suitable to a great extent essentially depends on the questions that the research aims to answer. The research that is presented in this dissertation is based on a combination of qualitative and quantitative methods by performing desk research, conducting interviews and a survey.

The following section illustrates the rationale of this choice.

5.1.1 A combination of qualitative and quantitative methods

This thesis has applied both qualitative and quantitative methods. The main reasons for the combination of methods in this dissertation are – as advanced by Greene et al. (1989) - firstly to ensure triangulation of findings in the traditional sense of seeking convergence of the results; secondly to ensure complimentarity in the sense that a phenomenon may show overlapping and different facets (as peeling different layers of an onion); thirdly it is applied in a developmental way where the first method (quantitative) is applied sequentially with the aim to inform the second method (qualitative); fourthly to allow for initiation in which contradictions and fresh ideas and perspectives may emerge and finally expansion, in which the mixed methods can add both breadth and scope to the study.

Different schools of thinking appeared in the debate on "paradigms", implying a method as such, but also the paradigm behind that method. Thus, the idea of mixing different methods raised questions concerning whether paradigms must necessarily be linked with research methods. For instance, if an inductive, qualitative research design is chosen, does this automatically imply that the researcher needs to apply qualitative data collection procedures such as through interviews or participant observation, while deductive theory driven approach would require experiments and surveys as key approaches to data collection. Linking paradigms with the specific methods forced researchers to choose between an either qualitative or quantitative approach rather than applying a combination of them (Reichardt and Cook, 1979). Thus, by applying this distinction to the whole research process and the research design of the entire study, differences can be found even in the way an introduction is written, the purpose and research questions or hypotheses are described, etc. (see Greene et al., 1989 for an extensive discussion on the extent of which other aspects than the method in the research design process - introduction, theory, research questions, hypothesis - can be derived from different paradigms in a particular study).

Quantitative and qualitative methods can be complementary. Usually, the outcome of qualitative research is very rich and very detailed information, covering a more limited amount of people and/or cases.

However, this, in turn, raises the in-depth understanding of a specific case. Quantitative research methods fit better if questions can be answered by applying standardized measures and, e.g., answers from people can be matched with beforehand determined responses matching specific categories (Patton, 2002). An advantage of this approach is the possibility to measure responses from a large number of people for a selected set of questions, which allows for statistical aggregation of data and comparisons. Hence, it provides a set of findings that is well generalizable, as opposed to the findings of qualitative research.

This thesis is comprised of a case study, combining quantitative (survey) and qualitative (interviews) methods to collect data, of selected firms that have participated in technology transfer projects with the College of Engineering and Technology at the University of Dar es Salaam. The following section explains why case studies are a suitable method to study the issues at hand.

5.1.2 Case studies

Case studies are an appropriate method of analysis when there is no data on the phenomenon being studied. More specifically, according to Yin, a case study approach is suitable when the objective is to explain *how* and *why* questions, for instance specific developments that took place (Yin, 1994: 6). Furthermore, case study research strategies are suitable when the research aims to offer a description, to test or generate theory (Eisenhardt, 1989). Consequently, case studies aim to develop a certain set of propositions which can be tested in related situations. To offer a description is part of the aim of this research. Furthermore, qualitative methods, such as the case study, are very suitable for studies where depth and detail of empirical material are needed.

Yin adopts a broad definition of case studies and argues that a case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident" (Yin, 1994: 13). Hence, adopting the broad approach means that we are dealing with case study as a research strategy where the key characteristics are the time scope of the phenomenon at hand and the intertwining boundaries

between phenomenon, i.e. research object, and its surrounding context. In this research strategy, one can differentiate between different phases which are first the research design, then the collection of data and finally the analysis of the collected data.

This role of a case study method is here in line with an understanding in social science of the importance of the inclusion of the context of a given object into the study. A key feature is therefore to directly include the context in which the research objectives are embedded as the context is seldom merely a background. Instead "exploration of how the context is structured and how the key agents under study fit into it – interact with it and constitute it – is vital for explanation" (Sayer, 1992: 248). Incorporating the context into the analysis implies that we may find a variety of factors influencing how and why processes develop the way they do.

Case studies as a research strategy have usually been recommended to be best suitable for exploratory research[19] (Yin, 1994). Exploratory case study research is used for analyzing a research object of which only limited information is available. Explanatory research analyzes why the phenomenon of a specific research object exists and identifies key determinants and related mechanisms. This is the core of this dissertation as there is hitherto very limited information on the technology transfer mechanisms to informal enterprises and the resulting technological capabilities that have been acquired.

5.2 Operationalization of the research questions and analytical framework

The research questions investigated in this thesis are the following:

- What technology transfer mechanisms exist in the TGT-CoET collaboration?

19 Yin (1994) has, however, argued that case studies are appropriate and useful for exploratory as well as explanatory research.

- What types of technological capabilities have been acquired by informal SMEs as a result of participation in one of the specific technology transfer mechanisms?

- What are the factors facilitating technology transfer to the informal firms?

Based on literature from technology transfer and technological capability building, a questionnaire (see appendix 1) was developed to identify the technology transfer mechanisms and to analyze the impact on technological capability building. In order to assess the level of technological capabilities that were acquired, two separate tables in the questionnaire were designed, one for products and one for processes. Each table included the specific activities belonging to the basic, intermediate and advanced level, respectively, as specified and presented in the analytical framework in the previous chapter. The surveyed firms were asked to mark only those activities that they perform in their enterprises and to indicate whether these capabilities were acquired and/or improved as a result of the collaboration.

For the assessment of how these capabilities have been acquired, a complex table was designed in which firms marked the sources of knowledge and technology that they have used during the past years and ranked their importance for the firms' operations. The table also included a question about whether this source was a result of the collaboration with the university or not, and whether these sources are foreign or local.

Apart from this table, a set of open questions concerning knowledge sources and collaborating partners was asked. This assured that firms could specify what domestic organizations not specified in the table they were collaborating with. It also gave them the possibility to specify in more detail what types of interactions they were engaged in with these collaborating organizations, i.e. whether they received technical assistance for technological processes, organizational changes or any other kind. The purpose of this set of differentiated questions on external collaboration was to investigate how the technological learning process has been carried out.

5.3 Data sources and information acquisition and analysis

5.3.1 Selection of cases and definition of unit of analysis

There are different sampling strategies with different logics of each approach depending on the overall purpose of each strategy (see e.g. Patton 2002). The sample of cases for this research follows a *purposeful* sampling (sometimes also called *purposive* sampling) (Patton, 2002). The reason for this is that actors have been selected due to their specific characteristics.

My main research interest is to investigate technology transfer and technological capability building in indigenous SMEs in the informal sector.

Against this background and the need to find and build linkages between formal and informal economic activities, a case of technology between a set of formal actors and informal actors was chosen. The actors of the joint collaboration that forms the overall case in this dissertation are CoET at UDSM, the NGO TGT and a selected number of SMEs of the informal sector that participates in the TGT-CoET collaboration. The firms that have been surveyed are all belonging to two Gatsby Clubs in Sengerema.

As a very first step, UDSM was approached with a general inquiry concerning interactions with industry, and the interesting case of interactions with indigenous SMEs through TGT was identified. From a first study on this collaboration and on the absorptive capacity that could be built in the indigenous firms as a result of the collaboration (see Szogs et al., 2008 for a description and analysis), further interesting questions emerged and the survey that forms the basis for much of the analysis in this thesis was designed and sent to the collaborating firms. The Gatsby Club Initiative showed to be a good starting point for establishing contact with informal enterprises. Therefore it was selected as a case for this thesis.

Thus, the aim has not been to sample for proportionality, but instead the goal has been to cover representatives of a specific group of actors.

5.3.2 Data collection

The empirical material that this dissertation contains is comprised of primary and secondary data sources. Primary data was collected through a survey and interviews with firms and other organizations in Tanzania. Secondary data sources that were used are: online data bases, brochures, policy documents, reports and evaluations. The list of organizations that was visited and persons that were interviewed is presented in appendix 3.

Concerning sources for data collection, Yin argues that a case study approach needs to be understood as a comprehensive research method which deals with a range of different sources of evidence, for instance interviews, documents, surveys, observations, etc. (Yin, 1994: 8). By means of triangulation of different types of data (i.e. to include documents, interviews and observations in the study), an easier construction of validity for the study is given.

As indicated earlier, the data that is used for the empirical analysis in this dissertation is based on primary and secondary data.

5.3.3 First step – secondary data collection

In order to assure triangulation of the data, this study draws on a number of sources of evidence. Secondary data was collected in form of policy documents, statements, evaluation reports of the collaboration of CoET and TGT, CoET brochures including brochures of the individual departments, catalogues over all the machines produced at CoET, country wide survey on the needs of SMEs produced in joint collaboration with TGT and CoET, overview and summary of all student projects that have been conducted in the CoET/TGT collaboration, information brochures on the incubator program in all regions and information brochures of the Gatsby Clubs. A large number of the university brochures on the collaboration were not online, but collected during the fieldwork in Tanzania. Furthermore, online databases have been searched, via Tanzanian as well as international websites that were consulted in order to find statistics about the Tanzanian socio-economic and STI context. The World Bank's programme "World Development Indicators Database" has been an

important source, as well as UNESCO's UIS, the Tanzanian NBS and BRELA.

5.3.4 Second step – primary data collection

Primary data was collected through a survey and interviews.

The survey data is appealing for the analysis of acquisition of technological capabilities and technological learning of firms, particularly in Tanzania, due to the fact that conventional measures for innovation, for instance statistics on R&D intensity or patenting, only exist to a limited extent. Firm level data of informal firms does not exist.

Detailed publicly available documented information on the various firms participating in the TGT-CoET collaboration is very limited. For instance, a comprehensive database of all the firms participating in the different mechanisms has not yet been compiled. Through a report[20], only the addresses and some of the phone numbers of all 7 Gatsby Clubs (which by now have been merged into 6 clubs) have been available.

It has therefore been necessary to conduct a survey in order to obtain a general overview of the phenomenon (i.e. the why-question) and firm specific information on the in-house conditions for technological capability building and the type of technological capabilities that were either improved or acquired as a result of the technology transfer. The interviews, however, have provided deeper information on the why and how questions. Both methods are thus complementary.

The survey was sent with a letter introducing the intentions of a study on the technological learning in the firms after joining the Gatsby Clubs and invited all Gatsby Clubs to participate in the study.

The only member that responded and was actively interested was the manager of the Sengerema Small Business Association. We wrote a

20 "Report on the status of the establishment of Gatsby Clubs and its proposed 3 year implementation plan (2005-2007)", CoET. 2005.

contract between CIRCLE and SSBA with the details about the proceedings of the survey.

We started with a round of surveys in English but it turned out that many members of the Gatsby Club were unable to answer the questionnaire in English. The questionnaire was then translated to Swahili (see appendix 2) by a knowledgeable fluently English and Swahili speaking person who is familiar with the field of innovation studies and works at UDSM with these issues. Approximately half of the firms answered the survey in Swahili.

For this dissertation, a total of 99 firms of the Sengerema Gatsby Club were surveyed. Due to a high percentage of responses missing some of the key variables used in the questionnaire, the actual sample of the firms that has been used in the empirical analysis was reduced to 88 firms. An overview of the whole sample, showing company name, year of establishment, location and industry belonging, is presented in the appendix 5.

It is essential to keep in mind that these small firms are mostly operating on a subsistence level and if, e.g., the rice has not been growing well during one season, firm owners are adapting to these circumstances and instead selling other products to ensure their income.

I had initially planned to investigate whether different patterns of industry classifications could be developed as regards the way TCs are improved or acquired and whether any interesting differences could be identified. Given the industrial "flexibility" of the firms, this was not further pursued.

The industrial belonging specified in the following table 3 reflects the answers that were provided in the survey.

Table 3: Industrial belonging of the firms in the Sengerema Gatsby Club firms

	Category	Number of firms
1	Livestock keeping (pigs and poultry)	5
2	Making local stoves	5
3	Making dresses/sewing clothes	22
4	Making drinks (juice, jams and local wines)	6
5	Making leather shoes and balls	1
6	Food processing and parking (flour milling and ginning rice)	26
7	Honey harvesting and making candle	1
8	Local medicine processing and selling	1
9	Palm oil processing	3
10	Crop farming (rice, cotton, cassava)	14
11	Motor cars/cycle covers making	2
12	Carpentry (making chairs and coaches)	5
13	Gravel making/sand processing	1
14	Making agricultural tools	4
15	Weaving	7
16	Stationeries	2
17	Fishing	6
18	Bricks making	2
19	Bakery	2
20	Hair dressing	1
21	Selling food and drinks	7
22	Welding	1
23	Vegetable growing (gardening)	3

Source: own survey data

Importantly, this classification into industry belongings has been done following the answers that were given in the survey concerning the industrial activity of the firms. The activities that were specified by the firms were then grouped to the industries in the above table with all firms showed.

Table 4: Sectoral distribution of surveyed firms

	Category	Percentage of firms
1	Agriculture	29.5
2	Textile	25
3	Food processing	17
4	Construction	5.7
5	Tool making	4.5
6	Fishing	5.7
7	Carpentry	3.4
8	Carving	1.1
9	Salon	1.1
10	Health services	1.1

Source: own survey data

The survey was followed by a series of interviews. Interviews were made with the manager of the Sengerema Gatsby Club (SGC), representatives of all the three different institutes at the College of Engineering and Technology at the University of Dar es Salaam, TGT and with indigenous firms belonging to SGC. Interviews were carried out with a number of different employees of the firms (director, managers, engineers, sellers). Through interviews with different persons, some crucial contradictory information was received and required additional interviews for clarification.

The manager of the Sengerema Gatsby Club confirmed that none of the firms included in the survey are formally registered and thus all belong to the informal economy.

To sum up, the firms that were used for the interviews have been chosen due to their specific characteristics that illustrate certain aspects of the complex phenomenon of technology transfer from the CoET-TGT collaboration and technological TC building as a result of joining Sengerema Gatsby Club.

From these characteristics and the choice of companies based on the survey analysis, I then went back to the actual firm information to see what company it was and whether the interviews could be conducted in English or in Swahili. Even those firms that had answered the survey in

Swahili were first asked whether the interview could be done in English despite of this, and only when this was not the case they were conducted in Swahili.

The interviews were conducted during July 2009 by a Swahili speaking Tanzanian. The recorded interviews in Swahili were then translated into English by a UDSM employee and sent back to me.

The selection of firms to be interviewed was done based on an analysis of the survey results. Based on the specific criteria, such as interesting results regarding the sources for knowledge acquisition and the type of technological capabilities (basic, intermediate or advanced), the firms for further case studies were selected. The criteria for knowledge sources included firms that had marked either a high importance of university interaction, and/or high importance of intermediate organizations, and/or licensing as crucial knowledge sources, and/or fair trades and exhibitions as a very crucial knowledge source, and/or consultancies as a crucial knowledge source.

There was also a counter group where these activities were not crossed as important in the survey. These case firms have thus been chosen in order to investigate in depth and illustrate how far different types of actors or mechanisms – to which the firms were introduced as a result of joining Gatsby Club – were contributing to the TC building of the firm.

5.3.5 Data analysis

The analysis of the data was done in several steps. The empirical evidence from the review of documents was summarized and several tables were built. The second step was to analyse the results of the 88 surveys. This has been done through descriptive statistics. I have generated a large amount of case processing with cross tabulation where I have analyzed how different issues asked and answered in the survey are correlated, i.e. whether for instance the internal capabilities of the firm are related to the type of technological capabilities that have been acquired; whether there are differences between industries; whether the acquired technological capabilities are linked to the type of knowledge sources that firms interact with, or to the amount of different actors they

are collaborating with (i.e. whether a firm has only one collaborating partner or several), or whether one specific type of actors in collaborations characterizes the firms that acquired the advanced technological capabilities (for instance NGOs).

Based on the results of the survey, I selected firms for interviews. The interviews have been taped and transcribed. I have also written impressions from the interviews and field notes directly after the interviews which have been helpful in parts of the analysis. In the analysis of the interviews, I have related the material of the interviews to the analytical framework of this research (as described in chapter 4). The types of technology transfer mechanisms were clarified through interviews with the manager of external relations at CoET, and both in the survey and in the interview analysis, all the elements of technological capability acquisition have very clearly followed the logic of the categories presented in the analytical framework (the distinction between levels of capabilities, regarding complexity, functions of capabilities and actors that have facilitated and contributed to the accumulation and learning process).

The types of answers that have been provided in the interviews have thus been analyzed by abstracting them according to the analytical categories developed. This has been a challenging task as many interviews vividly illustrated the very different nature of these firms and their daily operations as well as the immense gap of the content of the categories following the literature and the reality of the entrepreneurs (as will be discussed in the concluding sections). Despite great efforts, some interview results have been impossible to include as they diverged from a joint understanding on the issues at hand.

5.4 Reliability and validity

Reliability and validity are crucial to assure that the findings of the research are scientific. Reliability refers to the demonstration of a given study; the data collection process can be repeated and lead to the same results (e.g. de Vaus, 2001). It is important in this respect to correct

wording that cannot be understood by those that are interviewed or that fill in the questionnaires.

The question of validity can be dissected into several parts. Constructed internal and external validity is relevant for this study. According to Yin, constructed validity can be increased by using multiple sources, thus showing a "chain of evidence" (Yin, 2004: 34). Internal validity refers to the extent to which the specific research design allows to draw unambiguous conclusions from the results of the research. External validity refers to the extent to which research results can be generalized beyond the specific study.

In order to ensure reliability in this research, I made a pilot of the questionnaire with the manager of the Sengerema Gatsby Club and six firms. This first round of testing showed the need for some clarification in the way the questionnaires should be filled in.

To ensure that I was interviewing the correct person in the firm (the one that could answer the questions), I sent the questionnaire prior to the interview and appointed an interview time with relevant staff of the firm.

A potential bias in case study research can result from the fact that the researcher has his/her favorite examples which may limit the reliability (Ragin, 1987). The combination of the survey and interview method has been crucial in this respect in order to not exclusively rely on illustrations provided in the selected interviews, but to have a complete picture regarding the type of TCs that have been acquired and how they were acquired. Additionally, secondary documents on the technology transfer have been included.

The results in this thesis have been validated by triangulating the primary data with secondary data. The results have also been discussed with local experts of STI studies who have not been involved in the research and, hence, could comment and discuss without subjectively influencing the interpretation of the results.

Furthermore, in order to assure the internal validity of the research in this thesis, I used multiple sources of evidence in order to avoid my own bias. In addition to using multiple sources of evidence, the persons that

were interviewed have also been carefully chosen in order to receive views from persons involved in different phases and places of the collaboration of the technology transfer. In some of the selected firms interviewed, other staff than the manager was interviewed in order to receive a more nuanced picture regarding the acquisition of technological capabilities.

The survey has carefully been constructed to ensure that it can actually measure what it intends to measure. Hence, the survey questions have been pre-tested on persons in the field in Tanzania.

In addition to the more traditional issues of validity, there may be issues present in this case which pertain to the role of the researcher and the special circumstances presented by the research context. Any fieldwork in a developing country entails a number of challenges that add to the list of usual challenges related to doing fieldwork and conducting interviews. These challenges start even prior to the planning of how the fieldwork is to be done and what needs to be particularly considered. Vivid debate has taken place especially among researchers concerned with the power dimension inherently present when – even if stereotyped and simplified – comparatively privileged researchers from the West travel to a LDC and study the situation of people and their businesses who live and exist in – partly – extreme poverty. This phenomenon has for instance been referred to as "academic tourism" (Mowforth and Munt, 1998: 101), or fieldworkers have been referred to as "research travelers" (Clifford, 1997: 67).

Other reflections address the fact that some of the countries under study are former colonies of the Western countries from which the researchers may originally come and the inequalities and power that potentially feature this relationship have not yet been adequately investigated by academics (Madge, 1993). The post-development commentator Escobar (1995) expresses criticism regarding how the voices of Western "experts", as opposed to the undermining of the local people, have been legitimized in the way the development discourse was constructed.

A related consideration has been expressed by England (1994) when asking whether it is really possible to incorporate local people's voices without reinforcing a relationship characterized by a domination pattern.

Even if there are no straightforward answers to these issues, Western researchers have been forced to – and should continuously – reflect on these concerns. Particularly, when taking negative past experiences into account in which research has not benefitted the people and countries researched (Edwards, 1989).

I have without doubt experienced the fact that these positionalities have an impact on the different encounters from interviewing people to visiting manufacturing places of firms or for instance CoET. It can also be the mere fact that a researcher comes from a developed country's university which may signalize an image of being privileged – even if this may not be the case in terms of for instance income.

It has been argued that even if research in developing countries is not very different from social research as such, it requires a certain degree of sensitivity and specific skills in order to take the specific situation and conditions into account (Scheyvens and Storey, 2003). Specific conditions based on Scheyvens and Storey relate to:

- The fact that the local context and culture often being unfamiliar to the researcher

- The researcher not speaking the local languages that may be spoken and translations may be necessary, or all involved parts may speak a foreign language

- A possible danger that time in the field is restricted, and the researcher has no possibility of returning and filling missing information and questions

- Culture shock

- The researcher from a developed country possibly entering further up in the hierarchy of the studied society in the third world compared to his position in his home or residence place (see in particular Sidaway, 1992).

Additionally, the fieldwork was particularly challenging as some of the concepts used in the North, like university-industry collaboration or

technological capabilities, were hardly applicable to the reality of the informal entrepreneurs.

All these factors undoubtedly applied to my own research case in Tanzania. I have tried to handle them in different ways, been aware of them and in some circumstances I have probably simply been lucky.

6 TANZANIA- BACKGROUND

The aim of this chapter is to provide the empirical context of the research in this dissertation. It starts with a very general introduction to Tanzania and follows with a description of Tanzania's emergent innovation system, including information on S&T in Tanzania. This is used to frame the overall focus of this dissertation. In other words, this means that the characteristics of the Tanzanian S&T landscape and the political economy of the country justify the theoretical rationale for this thesis.

6.1 The socio-economic context

The United Republic of Tanzania was formed out of the union of two sovereign states, Tanganyika and Zanzibar in 1964. Tanzania is the largest country in Eastern Africa and one of the poorest countries of the world. Africa as a whole is a latecomer in development.

Tanzania has a surface of 884,000 km² and rich deposits of minerals along with a variety of other resources. However, the potential commercialization and the development of sustainable business models for many of them have not yet been fully explored and exploited (The International Bank for Reconstruction and Development/The World Bank, 2009).

The estimated population in Tanzania is 42 million people. The following map shows the population density of Tanzania, which clearly reveals the very high concentration of population in the urban areas as opposed to the rural areas. It also shows the different regions and illustrates, for example, the geographical distance from CoET and TGT which are located in Dar es Salaam in relation to the firms of the Sengerema Gatsby Club located in the Sengerema district around Lake Victoria.

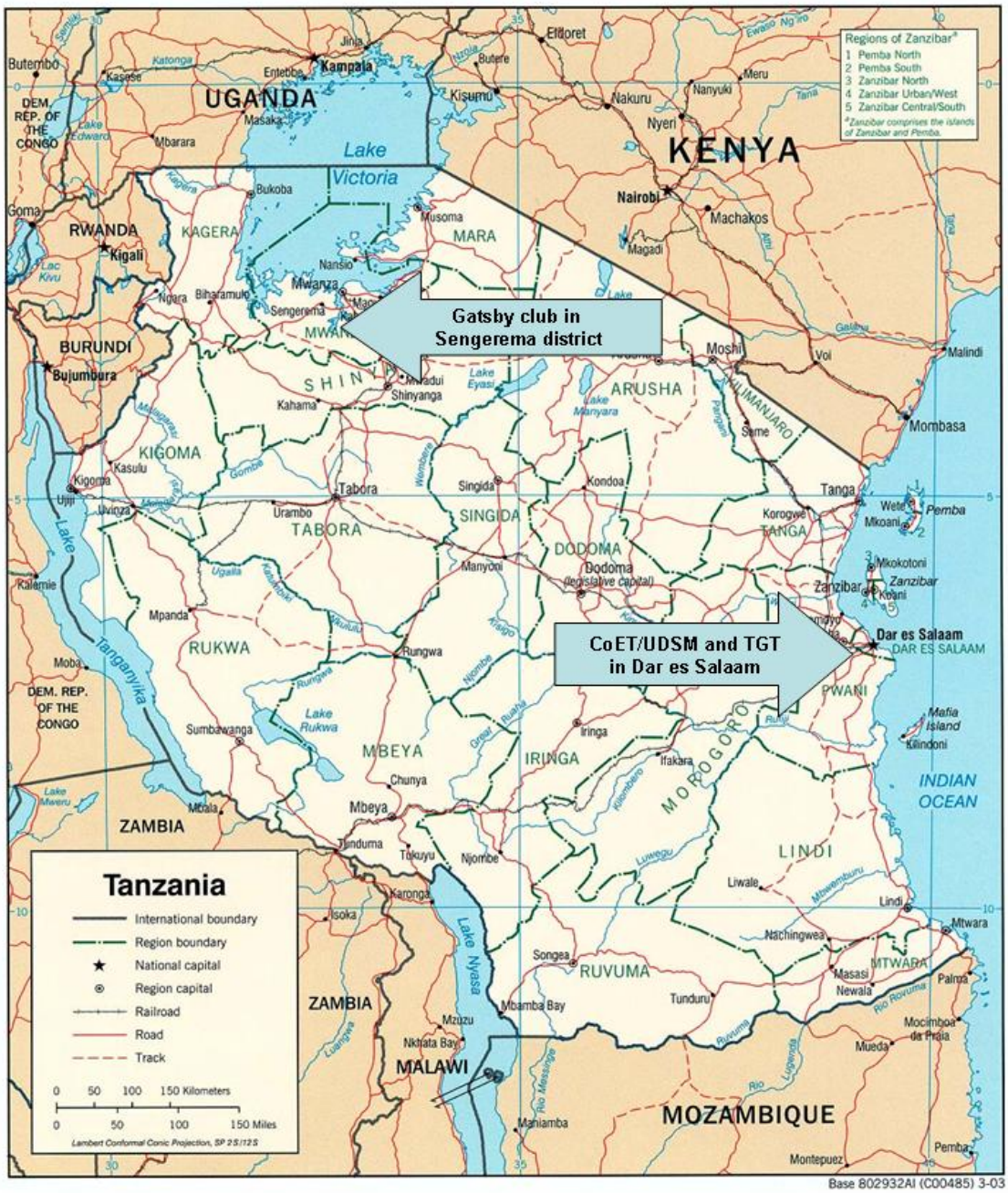

Figure 3: Map of Tanzania
Source: University of California (2008)

Only 7% of the population (NBS 2005) in Tanzania has access to electricity, which of course has major implications on the limited

possibilities as regards use of many machines in the exploitation of resources and production of products. Of the population located in urban areas, 38. 4% has access to electricity while it is only 1. 3% in the rural areas (NBS, 2005). Obviously, this has important implications for the STI infrastructure and constitutes a crucial constraint.

Half of the population lives below the absolute poverty line. The following table illustrates poverty in Tanzania. It shows that the population has increased by more than 8 million people over the past 8 years. The life expectancy is very low, with an average age of 56 in 2008 (for comparison, the world average life expectancy was 69 in 2007 which is the latest available date) and a high infant mortality rate. The literacy rate is somewhat higher for males, with 86% in 2000 compared to 78% for females, which surprisingly has decreased to 79% for men and 76% for women in 2007 which are the latest available data.

Table 5: Social data for Tanzania

	2000	2005	2007	2008
Population total (millions)	34.13	39.01	41.28	42.48
Life expectancy at birth , total (years)	51	54	55	56
Mortality rate, under -5 (per 1, 000)	143	124	116	..
Literacy rate(youth female, % of females ages 15-24)		..	76	..
Literacy rate (youth male, % of males ages 15-24)	86*	..	79	..

Source: World Development Indicators 2009 (World Bank)
latest year available * is 1990.

The Tanzanian economy depends very much on agriculture which accounts for almost half of GDP, 85% of exports, and it employs 80% of the work force[21]. The service sector contributed with 39% of the GDP in 2000, which decreased to 37% by 2005. Industry contributed

21 Over 80% of agriculture in Tanzania is comprised by subsistence and small holders.

with 17% in 2005. The following table presents some selected economic data for Tanzania.

Table 6: Economic data for Tanzania

	2000	2005	2007	2008
GDP (billions) US$) (constant prices)	9.08	12.77	14.61	15.71
GDP (growth rate %)	4.9	7.4	7.2	7.5
Agriculture (annual growth rate %)	4.5	4.4	4.0	..
Manufacturing (annual growth rate %)	16	17	..	..
Construction (annual growth rate %)	39	37	..	..
FDI/GDP (%)	5.2	7.5	4.1	..
ODA/GDP (%)	11. 6	11.1	17.6	..

Source: African Statistical Yearbook (African Development Bank Group, African Union and Economic Commission for Africa, 2009).

The Tanzanian economy has grown from about 2% per annum during late 1970s and early 1980s to an average of 4% during the 1980s and 1990s as regards overall growth (Utz, 2008). Importantly, despite the increase in GDP growth rate, poverty in the rural areas worsened between 1995 and 1998 in aggregate terms (ibid). A suggestion might be that there was an inadequate growth momentum not targeted towards the needs of the poor, which would require that, e.g., linkages are built with activities in the domestic economy, e.g. Diyamett and Wangwe, (2006).

From 2000 to 2008, an impressive average growth rate was measured. According to the Vision 2025, the Tanzanian economy should reach an 8% growth rate. Across all sectors, growth rates could be noted; however, services which decreased from 39% of GDP to 37. The different sectors' contributions to growth depend on the growth rate of the sector and the share of it in the whole economy. At current prices (2008), the shares of GDP for services are 52.1%, for agriculture and fishing 26.9% and for industry and construction 21.0% (NBS, 2009).

Surprisingly, the importance of FDI as a percentage of GDP has declined from 2005 to 2007, while official development assistance (ODA) has increased.

Traditional exports of Tanzania are coffee, cotton, tea, tobacco, cashew nuts, sisal and cloves. Non-traditional exports are minerals and metals.

The following table 7 presents an overview of selected science, technology and innovation data available for Tanzania. Another interesting variable to include would have been the number of researchers, this is however not available.

Primary and secondary school enrolment has increased drastically between 2000 and 2007/2008. Important STI infrastructure improvements are the increased internet users, which is also visible from an increased number of internet service providers as well as mobile phone subscriptions.

Table 7: Science, technology and innovation data for Tanzania

	2000	2005	2007	2008
Primary education enrolment, all grades (total)	4382410	7541208	8316925	8601814
Primary education enrolment, all grades (females)	2169937	3685496	4101754	4243671
Secondary education enrolment (total)	261896	524325	1020510	..
Secondary education enrolment (females)	120248	244571	477314	..
Tertiary education enrolment (total)	..	41419	55134	..
Tertiary education enrolment (female)	..	13206	17803	..
Internet users (per 100 people)	0	..	0.1	1
Data operators and internet service providers	..	23	34	60
Mobile cellular subscriptions (per 100 people)	0	0	0	20
Scientific ISI publications	269*	371	418	..

*latest available date

Source: World Development Indicators database, 2009 (World Bank), UIS 2009, Southern African Regional Universities Association (SARUA), 2007, NBS 2009, SARUA 2008; UniDEV, 2009 in Brundenius and Göransson eds. *forthcoming*.

The total output during the period 2002-2006 for Tanzania is 2172 ISI articles[22]. In comparison, the total output of ISI journals by SADC countries during the period 2001-2007 is 47,694 papers (SARUA, 2008). This is an annual average of around 6800 articles. The research output is clearly dominated by South Africa which published 38,232 of the total output. After South Africa, comes a group of four countries, including Tanzania on the first place in this group, followed by Zimbabwe, Botswana and Malawi who published more than 1000 papers during the seven year period. These are followed by Zambia and Madagascar who produced more than 500 ISI articles during the period

22 The total output for the years 2002-2006 in Tanzania is 2172 ISI articles. These could not all be included in the formal of the table (year 2003=316 articles, 2004=322; 2006=476 articles).

The majority of all countries has increased their ISI journal articles during the last three years, with the exception of Angola, Mauritius, Swaziland and Zimbabwe) who remained rather stable. A decline has not been found in any of the countries (ibid).

An analysis of the 2004 publications shows high international collaboration, and co-authored articles from Tanzanian organizations are mainly made in cooperation with USA (50), England and Denmark (25) (ibid).

The following figure shows the number of publications by organization in Tanzania during the years 1994-2004. In terms of scientific output, the University of Dar es Salaam, Muhimbili University College, Sokione University of Agriculture and State University of Zanzibar are the highest ranking.

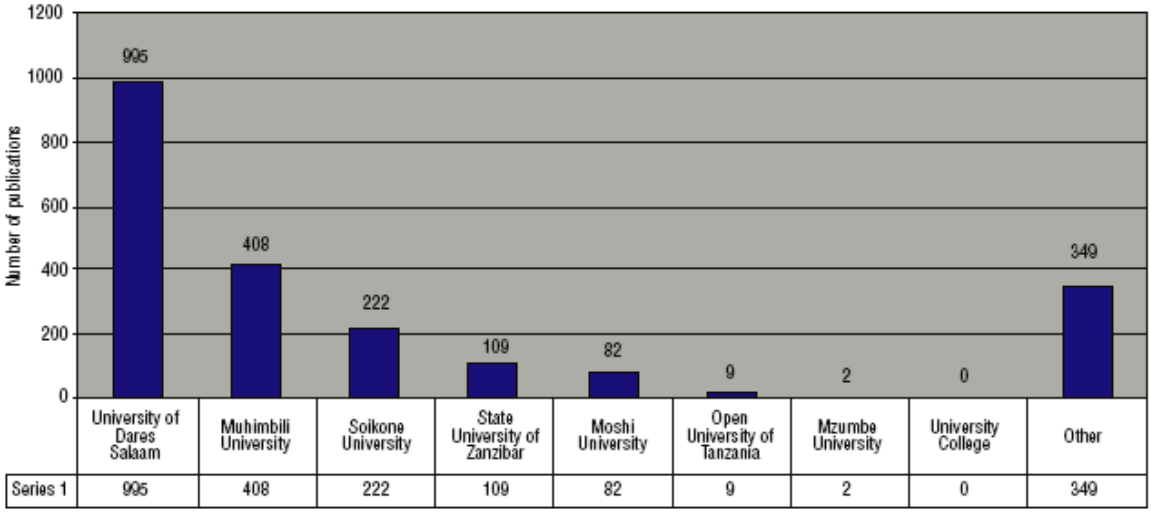

Figure 4: Main producers of scientific output
Source: SARUA, 2007: 176.

As the following table shows, the expenditures on education in general and higher education in particular have increased drastically over the past ten years. As table 10 in section 6.2.2 shows, most of the learning institutions in Tanzania have also grown over the past years; this is especially so for private and public primary schools as well as secondary schools. The picture is somewhat different for tertiary education. While the number of public full universities has increased from five in 2005 to eight in 2008, the number of public university colleges has remained

rather stable, from three in 2005 to four in 2007, but dropped to 3 again in 2008. However, both private universities and private university colleges have declined. In 2008, there are only 11 private universities left as compared to 13 in 2005, and only 10 private university colleges as compared to 18 in 2005.

Table 8: Tanzania higher education expenditure data*

	Total education expenditure (Million TZS)	Higher education expenditure (Million TZS)	Total education expenditure as % GDP	Higher education expenditure % of GDP
1998/99	107,457	19,000	1.59%	0.28%
1999/00	138,583	32,494	1.80%	0.42%
2000/01	218,051	46,679	2.53%	0.54%
2001/02	323,864	57,015	3.31%	0.58%
2002/03	396,780	70,540	3.52%	0.63%
2003/04	487,729	86,140	3.74%	0.66%
2004/05	504,745	84,315	3.37%	0.56%
2005/06	669,537	138,059	3.97%	0.82%
2006/07	958,819	209,859	5.08%	1.11%
2007/08	1,100,187.8	287,876	5.16%	1.35%

*Note that education expenditure data is compiled in Fiscal Years which is why the figures given in this table are in fiscal years.
Source: UniDEV 2009 in Göransson and Brundenius (*forthcoming*).

6.2 Organizational actors of the innovation system

6.2.1 Business organizations

In order to facilitate and stimulate innovation in SMEs, numerous strategies are undertaken by different actors, such as the College of Engineering and Technology (CoET), the Technology Transfer and Development Center (TDTC) at CoET and the Bureau for Industrial Cooperation (BICO).

In Tanzania, the following business organizational forms are mostly used: sole trader/sole proprietorship, partnership, private company unlimited, private company limited by shares, private company limited by guarantee, public company and cooperatives.

Most companies are individually organized and are companies where a single individual is the owner of the business, although other members of his/her family may participate and work in the company (**trader/sole proprietorship**). In this arrangement, the liability of the business owner is unlimited. All of his/her personal assets are at risk of losses incurred in the business.

In the **partnership** arrangement, relations are sustained between individuals that engage in business for the purpose of profit generation. These individuals are collectively referred to as firm. Every partner is liable for debts and obligations in the business.

A **private company unlimited** is an organizational form in which the legal status is separate from its members, but the liability of the members is not limited. The minimum number of members is two and the maximum is fifty. No minimum capital stock is required for the establishment of this form of company.

Private company limited by shares is usually formed by persons with prior relationships other than business relationships. The minimum number of members is two, the maximum is fifty, and there is no minimum capital stock required to create this form of company. The shares are not freely transferable. These types of companies may not list in the stock exchange. The member's liability is limited to the amount imposed on the share paid.

Also for the **private company limited by guarantee** the minimum number of members is two and the maximum is fifty. No capital stock is required for forming this type of company. The liability of its members is limited to the amount given as a guarantee and is payable only upon company winding up.

For a **public company,** the number of employees is different. The minimum is seven, and contrary to the private ones, there is no

maximum number of members specified. This type of company can invite the general public to contribute share capital and be listed on the stock exchange.

Another organizational form is the **cooperatives**, which are associations of persons that voluntarily joined for the purpose of achieving a common need. They all contribute equally to the capital required for the formation, and all accept the risks and benefits of the joint undertaking. This may be a primary society (10 or more persons), a secondary society or a federation. Apart from the cooperatives, BRELA is the official entity for the legal incorporation and registration. The Register of Cooperatives is responsible for the latter.

Table 9 provides an overview of the number of businesses in different types of public or private enterprises as well as the number of workers employed in the respective companies. The results are from a 2007 study performed by the Tanzanian National Bureau of Statistics. As the findings of the study summarized in the table show, the by far largest business is the individual/family business, which comprises more than double the workers employed by the government or other public companies. Also, non-profit organizations only constitute a very small percentage.

Table 9: Number of businesses and workers in different types of ownership for Tanzania mainland

Type of ownership	*Business*			*Workers*		
	Other region	**Dar es Salaam**	**Total**	**Other region**	**Dar es Salaam**	**Total**
Government	7,442	1,187	8,629	125,179	51,747	176,926
Public/private joint venture	127	155	282	7,637	4,837	12,474
Registered company	1,143	4,286	5,429	25,898	79,125	105,023
Non-profit operation	4,697	1,726	6,423	28,486	12,495	40,981
Cooperate	1,539	383	1,922	14,055	3,919	17,974
Association	1,048	534	1,582	7,581	4,298	11,879
Individual/family business	108,573	85,159	193,732	242,910	192,147	435,057
TOTAL	124,569	93,430	217,999	451,746	348,568	800,314

Source: NBS, 2007.

6.2.2 Education organisations

For an LDC, the S&T infrastructure of Tanzania is relatively well structured and sophisticated with three major public universities educating engineers and scientists. These are the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA) and the Open University of Tanzania. There are around 62 R&D institutes in Tanzania, which includes the three universities. These are distributed in a number of different sectors: agriculture (including livestock and fishery) (28

institutes), medical (11), industry (10), wildlife and fisheries (4), universities and other higher learning institutes (9).

The total number of education organisations in Tanzania is presented in table 10 below:

Table 10: Number of education organisations in Tanzania

	2005	2007	2008
Primary schools:	14257	15624	15673
Public	14053	15300	15257
Private	204	324	416
Secondary schools:	1745	3485	3798
Public	1202	2806	3039
Private	543	679	759
Public Full University	5	8	8
Public University Colleges	3	4	3
Private Universities	13	10	11
Private University Colleges	18	11	10
Non-University Higher Education	4	5	16

Source: NBS, 2009.

6.2.3 Government

The Planning Commission of the office of presidency coordinates national sectorial policies and plans. The Ministry of Science, Technology and Higher Education is responsible for the operation of Tanzania's universities and technical colleges. The Tanzanian Commission for Science and Technology (COSTECH) and the Higher Education Council were established in 1994 with the aim to coordinate the development and planning of higher education. In addition to these, there are a number of sectorial ministries with research departments, policies and research institutes which coordinate sector specific research activities which align with national priorities and plans.

In order to enhance industrial development in Tanzania, the government has established supportive industrial R&D organizations such as the Tanzanian Industrial Research and Development Organisation

(TIRDO); the Center for Agricultural Mechanization and Rural Technology (CAMARTEC); The Tanzania Education and Micro Business Opportunity (TEMDO); Tanzania Bureau of Standards (TBS); Small Industries Development Organization (SIDO); Board of External Trade (BET); Tanzania Industrial Studies and Consulting Organization (TISCO); COSTECH (advises the Ministry of Science, Technology and Higher Education and coordinates policy; it also promotes research activities throughout the country – as this is a crucial institute, it is described in more detail below) and the Technology Development and Transfer center (TDTC)[23]at UDSM.

A particularly important organization in the Tanzanian S&T infrastructure is the S&T policy advisory board, COSTECH. It is a parastatal organisation that was established in 1986 by Act of Parliament No. 7 as a successor to the Tanzania National Scientific Research Council. It started operating in 1988 and is responsible for the co-ordination and promotion of research and technology development activities in the country. One of COSTECH's major roles is to provide advice in S&T policy formulation and implementation matters. It is the chief advisor to the government concerning all issues on science and technology and their application to the socio-economic development of Tanzania.

All major national research and development institutes of Tanzania are affiliated to COSTECH. The heads of the affiliated organizations serve on the board of COSTECH, commonly referred to as "the Commission". Other members of the Commission include professors from national universities and policy makers from Ministries of both the Union and Zanzibar Government. COSTECH reports to the higher authority, the Ministry of Science, Technology and Higher Education.

Tanzania has a large number of research institutes which are either affiliated to COSTECH and/or the sectorial ministries. The ones listed in the table below are associated with COSTECH:

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23 Importantly though, it was stated that "most of these institutions have failed to perform as expected" (…) and industrial development should not only concentrate on development of entrepreneurship related factors, i.e. human abilities, organization, information, infrastructure and supportive services (UDSM, CoET and TGT 2003).

Table 11: Research institutes associated with COSTECH

Health: National Institute for Medical Research (NIMR)
Industrial research: Tanzanian Bureau of Standards (TBS) Tanzania Industrial Research and Development Organization (TIRDO) Tanzania Engineering Manufacturing and Design Organisation (TEMDO) Tanzania Bureau of Standards (TBS) National Housing and Building Research Agency National Construction Council (NCC) Tanzanian Industrial Studies and Consulting Organisation (TISCO) Institute of Production Innovation of the University of Dar es Salaam (IPI) Technology Development and Transfer Centre (TDTC) Tanzania Atomic Energy Commission
Food and agricultural research: Centre for Agriculture Mechanization and Rural Technology (CAMARTEC) Tanzania Fisheries Research Institute (TAFIRI) Tanzania Forestry Research Institute Tanzania Wildlife Research Institute Tanzania Food and Nutrition Centre (TFNC) Tanzanian Automotive Technology Centre (TATC) Tropical Pesticides and Research Institute (TFNC)
Energy research: Tanzanian National Radiation Commission (NRC)
Environmental research: National Environmental Management Council
Social Sciences research: National Social Welfare and Training Institute

Natural resources research:

Tanzania Forestry Research Institute (TAFORI)
Tanzania Wildlife Research Institute (TAWIRI).

Source: own draft

R&D in Tanzania is primarily carried through by governmental institutions (the parastatals) (Bongenaar and Szirmai, 1999). The "system of coordination and cooperation among various institutions and other actors in R&D is not as effective as it is supposed to be" (Wangwe, 1995) with partly overlapping activities and partly weak linkages between various actors that could benefit from each other's work (Diyamett and Wangwe, 2006). These necessary linkages are poorly developed in Africa in general (Mytelka, 1993), which also applies for Tanzania.

Importantly, despite the fact that most R&D is performed by the above mentioned governmental institutions, the government is only financing a very small proportion of the total R&D programs. The following section describes the financing of science, technology and innovation issues further.

6.2.4 Financing science, technology and innovation

There are striking disparities between developing and developed countries as regards R&D spending. While the R&D spending was US$500 billion by the 29 OECD countries in 1998, this amount was more than the total economic output of the 61 poorest countries of the world (which was US$464 billion)[24].

In a survey conducted by COSTECH (2005), it is estimated that government funding of R&D is 14% as opposed to foreign donors which fund almost half of the total R&D funding.

24 Data from World Bank's World Development Indicators (2009).

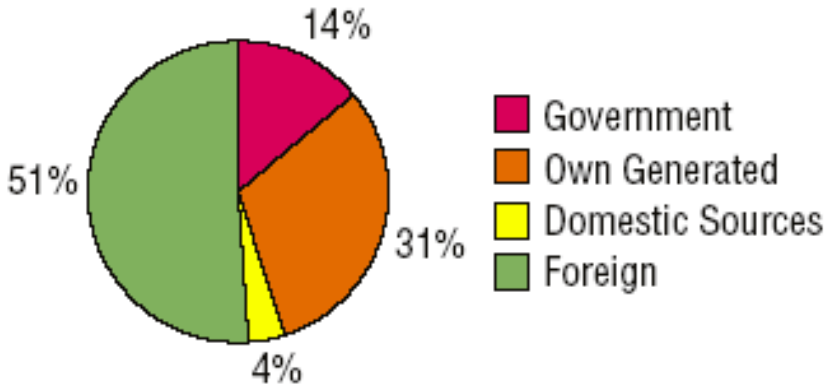

Figure 5: Proportion of source of funds to total 1995-04 flow to R&D programs in Tanzania.
Source: Southern African Regional Universities Association, 2007: 176.

Thus, foreign funding organizations are accounting for most of the R&D expenditures – which has important implications on the research agendas.

Due to lack of capital, there are high financial constraints to innovative activities in Tanzania. In 2001, Tanzania recognized the importance of microfinance as a tool for eradicating poverty and implemented a National Microfinance Policy. However, up to today, it is only accounting for a small proportion of the total bank credit and is estimated to count for less than 5% of all bank credits. The firms that participated in the technology transfer mechanisms (in particular the incubation and Gatsby Clubs) from CoET are receiving microfinance through TGT.

Microfinance is mainly provided through NGOs, a few commercial banks and Savings and Credit Cooperative Societies (SACCOs). The microcredit portfolio represents less than 0. 4% of GDP (The Gatsby Charitable Foundation, 2007).

Additional access to finance is complicated in the country and constrained by extensive bureaucratic procedures, a non-transparent system and corruption. Another problem is that microfinance NGOs are often depending on donor funding, while financial organizations are not

willing to provide loans to donor dependent NGOs. Further difficulties with accessing finance relate to the banking system in Tanzania (this limited penetration also partly connects to the large extent of the informal economy). It is extremely striking that only 6% of the total population has a bank account (ibid).

One of the organizations stated in this thesis, the NGO Tanzanian Gatsby Club (TGT), has played an important role in supporting the financial infrastructure. In particular, this was done by extending credit for on-lending and creating community financial structures through intermediaries, such as rural community banks. These groups are the Small Enterprise Development Agency (SEDA), FINCA Tanzania, the Presidential Trust Fund (PTF) and Mufundi Community Bank (Mucoba). Two community banks, Mwanga Community Bank and Tandahimba Community Bank, were established with the assistance of TGT. The key microfinance aims of TGT were to increase the credit portfolio from TZS 120 million (which is about 89,880 USD) to TZS 473 million (which is about 354,277 USD) by end 2008.

According to government regulation, however, microfinance institutions are not allowed to offer lower interest rates than the commercial banks. This led to tensions between the lending organization and the client, according to the intermediary bodies that TGT involved. TGT needs to carefully balance its task to develop the economy and its own earned profit.

6.3 Output of the system of innovation

Innovation systems (IS) and innovation activities – and hence the output of the system - in LDCs are rather poorly documented. Some countries have made an initial analysis of their science, education and technology system, but studies are scarce and not periodical. In particular, there is little material available about the "inner components and interactions of innovation systems" in LDCs (Aubert, 2006: 21).

Additionally, in most African countries, particularly sub-Saharan African countries, broad indicators on Science, Technology, Innovation and

R&D have not been collected. The systematic collection of this information is currently in process through the joint NEPAD/SIDA African Science, Technology and Innovation Indicators (ASTII) Initiative, initially including 19 pilot countries.

These indicators have not been collected in Tanzania either, apart from a one time occasion in 2005 – as presented below – where the objective was to determine how much the Tanzanian government spends on S&T and R&D activities as compared to donors. The next round of S&T and R&D data collection in Tanzania will be performed in connection with the ASTII project, and the work is in process.

There are only limited statistics available on the innovation output. There are no statistics on innovation outputs by private sector, like sales and exports due to new products. The only data that could serve a statistic purpose in terms of output are scientific publications (which have already been discussed in the previous chapter in connection with table 7 on STI data for Tanzania) and patents.

In Tanzania, patents are granted through an organisation called Business Registration and Licensing Agency (BRELA), which was established as a government executive agency under the Government Executive Agencies Act No. 30 of 1997. The official inauguration was in 1999. BRELA collaborates with the Regional office – African Regional Intellectual Property Organization - and the World Intellectual Property Organization (WIPO) on the protection of patents at regional, national and international levels. In addition to filing and granting patents, this organization also serves as a crucial information center for various R&D organizations, for instance regarding specific information on patents.

Patent information shows that patents for Tanzania are increasingly granted by the African Regional Intellectual Property Organization (ARIPO), while patents granted by the World Intellectual Property Organisation (WIPO) have drastically declined from the highest number of patents, 405, in 2001/02 to only 37 granted patents in 2003/04. In comparison, ARIPO granted 797 patents that same year. The National Office is still granting the lowest number of patents, even though it approximates the very low number of patents granted by WIPO.

Table 12: Number of patents granted in Tanzania (1999-2004)

	1999/2000	2000/01	2001/02	2002/03	2003/04
National Office	9	10	8	24	13
Via ARIPO	112	81	688	578	797
Via WIPO	198	207	405	281	37

Source: BRELA, 2004.

6.4 Science, Technology and Innovation Policy

Tanzania's transition to a market led economy started during the mid 1980s. Initially, the liberalization of the economy focused on removing constraints for private sector actors. Part of the reform program was also a) to restructure the public sector and b) to make an extensive privatization program. During the mid 1990s, the focus of the agenda for reform shifted towards macroeconomic stability and to secure high quality of the public financial management system.

Although there is an awareness of the importance of R&D for future development, the impact of policies on the Tanzanian industrial sector is still weak and the "rate of commercialisation and utilization of the few R&D results has been low" (Wangwe, 1995).

In 1996, the Ministry of Science, Technology and Higher Education published the National Science and Technology Policy as a response to the recognition that efforts towards sourcing and applicating new technologies and creating endogenous technological capacity needed to be grounded in adequate policy instruments. The major objective of this policy was to establish programs that could support the generation of new knowledge and strategies in order to applicate new knowledge, science and technology for development. Agriculture and livestock constitute the main areas, and the policy document stresses that science and technology should be applied in order to improve, sustain and increase the agricultural production in Tanzania.

Even in the Vision 2025 which addresses a number of economic and social development objectives to be reached by 2025, particular emphasis is also given to the importance of innovativeness, and in this connection

the low productivity in the agricultural and other sectors is emphasized. This is explicitly linked to low levels of innovativeness, including insufficient use of science and technology and low levels of education. The latter is due to low student enrolments, gender imbalance, poor financing, an under appreciation of the value of academic programs, uncontrolled and unregulated proliferation of tertiary training institutions. Among the various strategies to address is also the hurdle to better match the curriculum of higher education organizations to the changing role of science, technology and innovation in development.

Another way to address the development and growth objectives has been outlined by improving the capacity of Tanzania's domestic sector to learn, adapt and assimilate foreign technology, mostly through spillovers resulting from FDI (UNCTAD, 2001: 92-93). In order for this to happen, the need for a systemic approach has been highlighted and a model for a potential SI on a national level proposed (ibid: 85).

Policies that apply a systemic perspective and encourage interaction among the actors, linking particular to the private sector, are seen as crucial for technologically weak economies like Tanzania (ibid: 84). The domestic enterprises comprise the centre of such NSI, and these are linked with varying strength to the other actors in the system. In the proposed NSI, it is indicated that some links are weak or even non-existent[25]. However, all these policies focus mainly on the acquisition of foreign technology.

After this broader, macro oriented presentation of socio-economic features, industrial development and growth in the formal economy, the following sections proceed with information on the informal economy in Tanzania.

25 For a complementing overview of technology support, institutions and major public sector institutions involved in FDI as well as a diagram over the proposed NSI, see UNCTAD, 2001: 76 and 81.

6.5 Overall profile of the informal economy in Tanzania

Before providing a summary of the informal economy in Tanzania based on the most recent available data, I would like to stress again that it is extremely difficult to estimate the exact size of the informal economy (ILO 2002b).

Measurement methods to capture the size of the informal economy and how it contributes to national accounts exist, but informal economy data is often compared with total workforce data. The informal economy data does not include agriculture, however this is included in the total workforce – with the result that the informal sector is underestimated. As a consequence, the use of GDP as an indicator for economic development is for instance not always accurately providing a picture of the situation in the country (Charmes, 2002)[26].

Household surveys or mixed surveys – enterprise and household - were recommended as best suitable to describe economic activities in the informal economy most accurately (Flodman Becker 2004). The procedure in these surveys is to select a sample of households and in these households identify – following the new 1993 ICLS definition that includes specific criteria of employees - which persons belong to the informal economy.

Estimates show that 34% of all households in Tanzania mainland are participating in activities that belong to the informal economy. In urban areas, the number is higher with 55% of households belonging to the informal economy in Dar es Salaam.

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26 Another important aspect is that "with regard to the labour force, the main purpose is to segment the population of wage employees enumerated in the population census or the labour force surveys, in order to determine which ones belong to the informal sector (enterprises of informal employers) and which ones to the formal sector. It is in fact practically impossible to strictly apply the concept of informal sector, as surveys do not generally include questions on the economic unit in which the employee works. Comparison then has to be made with data on establishments or enterprises (surveys or administrative records). The degree of approximation will depend on the quality of the sources used" (Flodman Becker, 2004: 15).

On average, an informal enterprise is operating during 8 months per year. One third of all informal personnel is employers. Trade, restaurants and hotels constitute the highest proportion of the overall informal work force in Tanzania. This differs, though, from region to region. In Dar es Salaam, selling cooked food is the major business area, and in rural areas it is the region specific agriculture and livestock keeping (The Planning Commission and the Ministry of Labour and Youth Development, 1991).

The first socio-economic study of the informal economy in Tanzania was carried out in 1991[27] – as a response to international donors and the government's interest in further developing and specifically addressing the informal economy.

In this first comprehensive survey, the informal economy was profiled as consisting of about 1.8 million enterprises. 60% was located in rural areas. The findings of that survey revealed that most of the employees were not formally skilled (80%) or trained in the job (10%). Skilled artisans were only 5%. The training in the enterprises was usually provided for paid and sometimes unpaid employees.

More work has been produced on the informal sector in Tanzania since that first survey. An important policy document was the *"National Policy for Informal Sector Promotion"* (URT 1994). This document addresses the key constraints and offers specific strategies for the reform of the informal sector.

It also differentiated between *"micro-enterprise"* and *"subsistence"* as two different categories. The former captures those enterprises that demonstrate the capability to expand and create wealth, while the latter covers those enterprises whose operations are purely strategies to survive. These are the majority of the sector.

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27 *The 1991 National Informal Sector Survey* was conducted with the assistance of the UNDP/ILO through Project URT/85/011 on Developing Labour Market Information and SIDA through its support to the Bureau of Statistics and to the Social Dimensions of Adjustments (SDA) Project.

The policy document pointed to the importance of structural change in order to facilitate operations and expansion opportunities for the enterprises. Access to loans, to new technologies and marketing capabilities was also stressed, as well as the importance of education and training.

Since the beginning of the 1970s, Tanzania has tried to eradicate informal economy activities through specific policies.[28] The ideological view during the seventies was the vision of a classless society and the understanding of informal activities being corrupt since they operated outside the legal system.

The severe economic challenges during the 1980s and strong pressure from international donors led politicians to reconsider this part of the Tanzanian economy and instead view the socio-economic potential that the informal economy provides. Since then, a number of studies and policy documents have been produced by national and international agencies as well as the government with the overall aim to provide assistance and incentives for informal economy entrepreneurs and enterprises to increase their production and further develop their businesses.

The attempts and policy actions during the 1980s failed to tackle the informal economy challenges in a more nuanced way and they did not separate well established enterprises from unemployed persons with criminal activities. It had also proved difficult to identify relevant client groups due to lack of coordination in the public sector as well as lack of reliable data (e.g. Kahama et al., 1986).

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28 For instance in 1973, urban trading licenses were no longer issued for traders that were self-employed. In 1976, self and unemployed persons in Dar es Salaam were tried to be settled in specific villages. In 1983, the government created a Penal Code amendment in connection with its activities against so–called "economic saboteurs", which labelled self-employed persons as "unproductive" and "idle disorderly persons" that had to be sent away from cities. A last large attempt was conducted in 1984 through the Human Resources Deployment Act. This act introduced and required official identification cards. Unlicensed self-employed persons who could not provide such official identification cards were resettled in villages in the countryside. Thus, rural self-employment was to some extent encouraged, but in urban areas it was prohibited.

The rapid growth of informal economic activities – in both rural and urban areas – during the 1980s was not government's intentions. It was the result of survival strategies of many people, as sufficient commodities were not offered to all those in need, including the very poor; however, it was offered to the formal economy (Kahama et al., 1986, Maliyamkono and Bagachwa (1990).

This situation has maintained the same during the 1990s partly due to a continuous decline of formal sector wages together with an increasing number of unemployed young people. Even formal economy employees are forced to seek additional income through informal economic activities. It has been estimated that more than 70% of publicly employed persons may be involved in one or more activities/projects in the informal economy (Omolo, 1989).

One of the new initiatives, the TGT-CoET collaboration with informal SMEs, is the focus of this thesis. Its objective is to help these enterprises by means of financial support and access to technology, but also by assisting in the process of formalizing their activities.

Since the late 1980s and 1990s though, a number of studies have investigated the potential of the informal sector, in terms of income generation as well as employment (Kent and Mushi, 1995)29. The sector consists of semi-organised and unregulated activities undertaken largely by the self-employed. This provides latitude and flexibility for a broad range of decisions in terms of personal initiative and innovation, the size of the enterprise, the choice of technique and the utilisation of income.

- There are only minor barriers obstructing entering into all of these activities which creates a potential base for rapid expansion, once the opportunities and incentives are present
- These studies consistently find that the sector is relatively more labour-intensive, more efficient, more profitable, saves more on skilled labour and foreign exchange and can generate more jobs with smaller capital outlays than large scale formal sector activities. This

29 Researchers who have studied the informal economy in Tanzania are Bagachwa & Ndulu 1975; Aboagye 1985; Tripp 1989; Komba 1989; Omolo 1989; Wagao 1989; Katabaruki 1990; Maliyamkono & Bagachwa 1990; ILO 1991.

reduces its vulnerability to external shocks compared with the levels faced by the formal sector

- There is also considerable evidence that IS entrepreneurs can mobilise their own savings.

Constraints:

A lack of capital for financing informal sector enterprises either to start operating or to encourage growth

- A lack of infrastructure such as business premises/sites with the appropriate utilities (water and electricity) and marketing
- A scarcity of raw materials means that they are sometimes unavailable even when operators have the money to purchase them
- A lack of encouragement from the local government which inhibits expansion and lack of implicating the potential of the sector to absorb unproductive labour
- Limited access to formal technical and vocational training makes it difficult for most of the entrepreneurs to obtain the required skills, both technical and managerial, required to operate enterprises successfully
- **A lack of relevant knowledge and skills, i.e. technical *know-how*, as the majority of informal sector operators only have primary education.**

The last point listed above is one of the crucial aspects of this thesis as it investigates the transfer of technical know-how and other technological knowledge from a university to informal firms.

7 TGT- CoET COLLABORATION: TECHNOLOGY TRANSFER FROM FORMAL TO INFORMAL ACTORS

This chapter starts with an introduction of Tanzania Gatsby Club (TGT) and The College of Engineering and Technology (CoET), the main actors of the case study in this dissertation along with the informal enterprises. It also provides background information on the objectives of TGT and the specific collaboration with CoET. It continues with a presentation of the different technology transfer mechanisms that were put in place in order to address urgent needs of SMEs. After this, a detailed description of the Sengerema Gatsby Club, including an overview of the specific industrial activities that the participating firms of this Club are engaged in, is provided.

7.1 Introducing TGT

TGT has been present in Tanzania since 1992 and receives funds from the Gatsby Charitable Foundation and the Ashden Trust in the United Kingdom. Gatsby Trust is a non-governmental organization which has functioned as a funding body for projects in East Africa since the 1980s; it is administered under the Gatsby Charitable Foundation, a British organization. The funds and loans are managed both from London and through local organisations in Africa[30].

The main objective of TGT is to contribute to poverty alleviation and advancement of education in Tanzania. The operations of TGT rest on the view that the Tanzanian SME sector has a high productive potential which needs to be mobilized. The overall mission of TGT is thus to assist and enable small and micro entrepreneurs to increase their output and net income through the provision of finance, training, technology development support and market strategies. More specifically, TGT's role is to:

30 These local organisations were set up with the help of Gatsby and are The Kilimo Trust African Agricultural Capital, Cameroun Gatsby Club, Kenya Gatsby Club, Tanzania Gatsby Club (TGT) and Uganda Gatsby Club.

- Provide funds for the training of artisans and other entrepreneurs;

- Support credit mechanisms within intermediary organizations which operate revolving funds

- Make grants or loans (through intermediaries) to producers organizations and associations to finance equipment and infrastructure

- Finance research in applied technology of relevance to small scale producers both within and outside Tanzania

- Assist in the marketing of the products of small scale producers both within and outside Tanzania

- Undertake joint funding with other relevant agencies within Tanzania

- Act as a channel for other funds raised both locally and internationally

(TGT, CoET, UDSM 2002: 2).

To accomplish its role, TGT has different funding options to support SMEs in Tanzania. These different funding options that TGT offers reflect the diversity of microfinance and technology support through a variety of activities on different levels. The key goal and interventions are, however, targeted towards the support and sustainability of SMEs. To receive support (including technological support) from TGT, SMEs are required to join one of the local or regional Gatsby Clubs. The support from TGT is then channeled to the SMEs through the clubs.

7.2 Introducing UDSM and CoET

The University of Dar Es Salaam (UDSM) is the largest and oldest university in Tanzania. It is responsible for the education of more than 70% of all university enrolled students in the country which is covering around 15,000 people (Mwamila and Diyamett, 2006) – in comparison the tertiary total enrolment number for 2007 is 55,134 students according to UNESCOs UIS database (2009).

It is indicated that UDSM is explicitly trying to build linkages with all potential actors of the Tanzanian NSI and attempts to strategically incorporate them into its research agenda (CoET, 2008). This is linked to expectations of financial benefits and high quality outputs. At present, however, most of the linkages that have been established are not yet registered, and there is overall only very limited interaction between the university and other actors in the IS (Mwamila and Diyamett, 2009; Diyamett, 2005; Wangwe et al., 2003).

The College of Engineering and Technology (CoET) has been established as a result of integration between the Faculty of Engineering (FoE) and the Institute of Production Innovation (IPI) at UDSM. The objective of CoET was to become the leading institution within engineering and technology at national and regional level (Mwamila, 2001).

The College of Engineering and Technology (CoET) started formally operating in 2005 and was the first fully equipped Campus College of the University of Dar es Salaam. The inauguration took place in 2006. The structure of CoET is based on three specific pillars: teaching and research, consultancy and services and technology development and transfer. Each of the activities/pillars has its own organisation. There are teaching, learning and research faculties (Faculty of Civil Engineering and Built Environment (CEBE), Electrical Computer Systems and Engineering (ECSE) and Mechanical and Chemical Engineering (MECHE), a center for Consultancy Services at the Bureau for Industrial Cooperation (BICO) and a center for Technology Development and Transfer (TDTC)).

TDTC constitutes the unit of UDSM with major external links. TDTC coordinates technology brokerage as well as transfer of technology to industry. The primary aim of TDTC is to assist in SME development and to have an impact on the public by developing and disseminating technology of relevance to the society. It is involved in most of the different mechanisms as part of the TGT-CoET collaboration. One of its main functions is the technology incubation project.

BICO's (established in 1990) main objective is to enhance CoETs capability to contribute to Tanzania's industrial development. Hence, a major intention is to optimize expertise and resources that are available at CoET for addressing technology and societal engineering related problems.

In 2007, the total number of employees of CoET was 346 (latest numbers available) with either permanent or contract basis at UDSM. This number includes 150 academics, 123 technical staff and 73 administrative staff. The academic staff can be further divided into 8 professors, 22 associate professors, 43 senior lectures, 20 lecturers, 32 assistant lecturers and 25 tutorial assistants. Importantly, it is stressed (CoET, 2008) that the technical staff at CoET is closely collaborating with the academic employees in order to secure high quality teaching and learning, but also in the areas of technology development and various services and consultancies that CoET offers to the industry.

7.3 TGT-CoET collaboration - background and motivation

The first paragraphs of this section will first present the background of the TGT–CoET collaboration in terms of the extreme poverty, particularly in rural areas, and the related urgent needs of SMEs. The section proceeds with some information about the operations and role of TGT. This is followed by a description of the specific collaboration with CoET, when it started, how it developed and which specific objectives that are addressed in this collaboration.

In Tanzania, as in many other LDCs, the rural population is far more disadvantaged than the urban population. For example, a typical rural household produces 42% of the food it actually consumes while in urban areas these are 18% and 3% in Dar es Salaam.

One of the motivations for the collaboration is related to the challenging fact that rural SMEs are faced with a number of shortages, as for instance long distances to drinking water, lack of electricity, limited capital and an overall insufficient infrastructure. Therefore, one particular important aspect in reducing poverty is that adequate technologies can reach SMEs in the rural areas, not only to boost their incomes but also to improve their living standards.

In the next chapter a specific collaboration between TGT and CoET with informal SMEs is investigated. In this context, TGT and CoET started to collaborate in the field of technology development and transfer in 2001 with the overall aim to benefit SMEs by helping them to access appropriate technologies generated by CoET and other services that the University Entrepreneurship Centre (UDEC) offers. The overall goal of this collaboration, which continues today, is to enhance the performance of SMEs through technology transfer and adequate acquisition of technology.

In order to achieve this goal, a memorandum of understanding was signed between TGT and CoET in February 2002. This document describes the specific roles and tasks of the collaborating partners and concrete implementation modalities and was accompanied by a small cash injection in order to assist SMEs to access the technologies developed by CoET. In May 2002 under the Principal, professor Burton Mwamila, CoET submitted an extended proposal to TGT for TZS 290 million (about 217,210 USD) to fund a more comprehensive support for the SME performance. A three year period was granted with an amount of 167 million TZS (about 125,083 USD). CoET in its turn developed into a crucial cooperator for TGT in their efforts to support informal SMEs through training and access to technology.

The role that TGT is playing in these joint collaborations between CoET and informal SMEs is that of a financer. TGT provides financial support

to COET for technology transfer projects to informal SMEs, while it is mainly the CoET employees that are responsible for the actual transfer.

The specific objectives of the collaboration include: to provide further exposure of engineering students to the issues and problems facing SMEs, to provide assistance to a selected group of such students in developing final year "projects" of direct relevance to identified SMEs, to facilitate the development of business plans for specific SMEs using members of the University bodies (CoET and UDEC) and to carry out research and development of new proto-types for SMEs (Katalambula et al., 2006).

CoET was the initiator of the collaboration; the very initial idea was based on CoET's initiative and since they needed money to materialize their ideas TGT was approached. An initial main motivation for CoET has been to do research and produce some prototypes, and it was difficult to transfer that technology to the local SMEs. The initial focus of the collaboration was on food processing, but has since then expanded its range of activities.

Thus, apart from developing and offering prototypes that are of need and help for local SMEs, it is at the same time also a market for CoET. In particular through the clubs, but also through the incubator project and student projects in which CoET is trying to market their prototypes; i.e. it is a marketing strategy.

CoET is not supposed to make real business, and they cannot start mass production for sale because that will go out of the university mandate, but there exists a large catalogue with prototype products that can be bought and mass produced elsewhere. Thus, identifying relevant SMEs is one of the major tasks performed by CoET in this respect[31].

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31 And this particular element – finding SMEs which can perform the production – is still a problem in this country. For machinery production there is one cluster in Morogoro which is producing a lot of agro-machinery, and CoET has been working together with them in Dar es Salaam, trying to acquire some different perfection of some of the machines, which is working well. In the long term, this particular entrepreneur in Morogoro will take over the entire mass production of some of the

In 2002, CoET started to conduct what later also has been referred to as feasibility study, more specifically this was the conduction of an SME survey. This survey was supported by TGT in 2004. The target groups of this survey were SMEs that were technology based, not traders but people who could manufacture something. Consequently, the aim was to identify the technology gaps, and after these were identified, different approaches were thought of as to how to address the problems.

In order to achieve the objectives of the collaboration, a number of different technology transfer mechanisms have been implemented. These are student projects, the creation of the incubation program and Gatsby Clubs (which has had already been successfully implemented in Uganda).

7.4 Technology transfer mechanisms used in the TGT/CoET-informal SME collaboration

As indicated earlier, the TGT funded collaboration between TGT/CoET and informal SMEs on appropriate technology acquisition and transfer dates back to 2001. By 2007, the projects had been increased and a number of different mechanisms were designed (either newly designed in the Tanzanian context or adopted from experiences in other countries, such as the concept of Gatsby Clubs that had already successfully been implemented in Uganda) in order to address the urgent needs of indigenous SMEs.

The first important step in the collaboration was the performance of a country wide survey on the status and needs of SMEs in Tanzania and mechanisms to address them.

In the following paragraphs the different technology transfer mechanisms used in the TGT/CoET - informal SME collaboration are described. These are first the student projects, then the incubator program and finally Gatsby Clubs.

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machines and supply that all over the country – in such case the role of CoET is fulfilled.

7.4.1 Student projects

The student projects are carried out by TDTC at CoET and conducted according to the following procedure: A university lecturer with contacts to SMEs introduces the students to potential collaborating SMEs. These are not only the SMEs under the TGT-CoET program, but any other SME. This requires that students and often supervisors contacting the SME to develop the idea; once the product or technology is developed, they bring it to the SME, where it is often tested and then installed. Sometimes SMEs come up with proposals and then look for students together with a university lecturer[32].

Thus, the students are involved after CoET has identified some problems that the SMEs may have[33]. They meet and really investigate what type of problem the firm is facing, and once it is specified and confirmed that there is a real need for improvement or a good business idea, students are involved who can try to respond to the specified ideas or needs.

Before the project is started and funded, the project must have a collaborating SME. Thus, there must be an SME which needs that particular end product. These SMEs could be one of the members of the Gatsby clubs[34].

In total 86 student projects have been implemented in the period 2001-2008 (UDSM, 2008).

Some of the successful student projects in which effective technology transfer occurred are described next.

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32 External Links coordinator, CoET-UDSM (2009), emphasizes that "*…unfortunately they cannot pick the students themselves for there is a procedure for assigning student projects so if you are lucky you get a good student then a lot is done if you do not get the right student then you find things are not on the right track*".

33 The survey helped them identify problems.

34 Alternatively, it is a member of the clusters belonging to the innovation systems and clusters program run by CoET or the incubators, in some cases even any other SME that a lecture knows about, so it can go beyond those firms belonging to these different programs.

Project 1: Cycron for a maize milling machine

In 2007, there was a project in which a new cycron for a maize milling machine was developed by CoET with an SME, tested together and later given to the SME; a cycron which actually receives flour after it has been milled. It is a long and complicated technical process. The design and functioning of the machines used so far are rather poor and tangential. With the improved changes, more flour can be produced due to less rotating and disturbance in connection with the heating when the air enters.

The project was so successful that TDTC continued with the improvement of the maize milling machines and informed other SMEs about the losses in terms of flour and dust. TDTC gave away two such improved machines, one in Dar es Salaam and one in Morogoro.

Project 2: Machine to clean the coconut shell

A fourth year student developed a machine which can clean the coconut shell. A lot of jewellery is made from the coconut shell, for example ear rings, but the shell has to be cleaned properly to make the surface very smooth.

One SME came up with the problem of the cleaning of the coconut shell to TDTC. Based on this request, TDTC developed a machine for this. By using this machine, the shell is made shining in a less labour intensive way than when it was done manually and also with a large improvement in the quality of the final product. Hence, the result was faster, cleaner and more shining.

The potential spillovers for other firms and applications have been discussed, including to upstream actors in the value chain. For instance, for cashew nuts, there could be more potential applications. As in the previous project, TDTC proposed to further inform about all the potential products that could be developed from cashew nuts or coconut, i.e. the entire value chain and the different products.

Project 3: Nutritional flour

> *"We have another student project on flour mill, nutritional flour which is mainly for infants. They mix different vegetables and flour from cereals to get a better nutrition. That is about to go to the market but it has not reached there yet. It started as an undergraduate project and was taken over by a master project. Now the entrepreneur is trying to develop that in the market."(Project coordinator, BICO-UDSM, 2009).*

7.4.2 Obstacles

While some of the student projects were successful, many of them could not be transferred straight away.

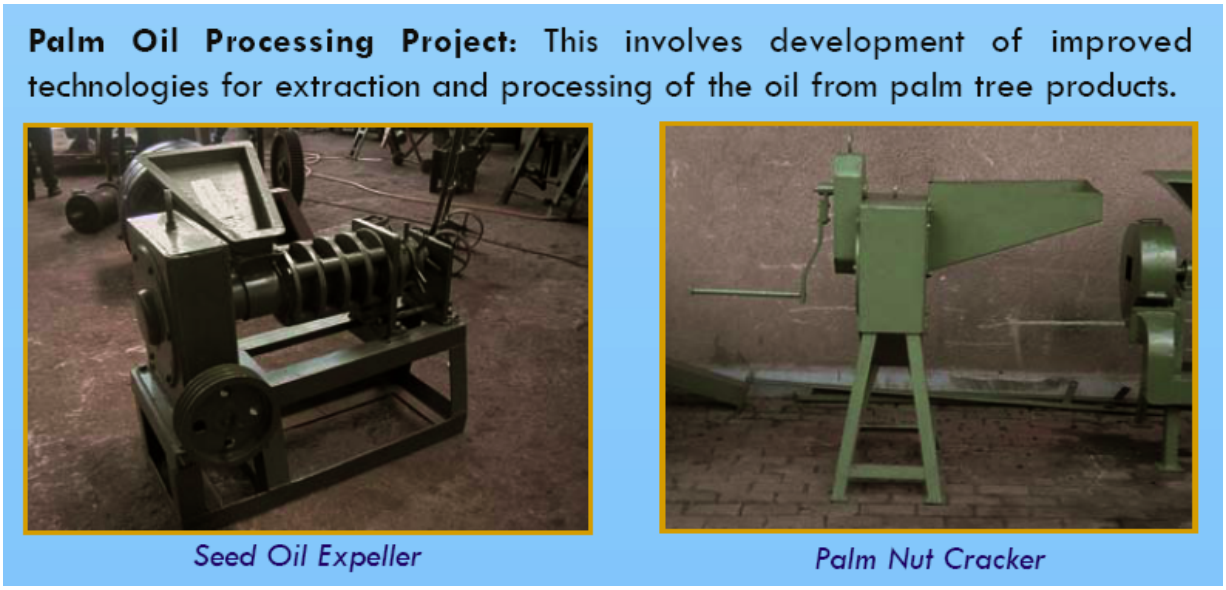
Main obstacles for the student projects have been related to the limited amount of funding provided. The coordinator for external links stresses that

> *"... regarding that small funding is not enough, we even discussed with TGT last year telling them if you want more output from the students to go to the entrepreneurs, they have to provide more money because research normally needs more money because what they used to provide is about 500 US dollars which if you go to buy equipment or chemicals I do not think you would get any equipment" (Coordinator of external links, CoET-UDSM 2009).*

A crucial concern was expressed from persons at TDTC regarding continuous interactions with the recipient SME of the technology. It was highlighted that after a specific technology has been transferred, there has not been any follow-up of these technologies that TDTC has developed. For example Dr. Elias, coordinator of the external links at TDTC, emphasized that:

> *"There is no feedback mechanism. Have they produced any more? Are there any problems? How could the technology be changed? That linkage is just one-way. Its weak, the back and forth is not there… but also there is not a proper procedure of actually making sure it's done from here to here, you see… "(Coordinator, BICO 2009).*

The type of problems that many of the SMEs face cannot be solved with the current amount of 500 USD provided for the individual student projects. If a sound solution is expected, this amount would need to be increased to around 1500 USD at least. This was a problem for TGT, hence, the amount of funding became the bottleneck and therefore these plans have not materialized and CoET is considering whether there are other potential ways of better exploiting and linking different technology development and transfer options.



Picture 1: Palm oil processing project
(Source: TDTC brochure)

7.4.3 Enablers

The technology transfer process through the mechanism of student projects appears to have been enabled through the knowledge of the students and their lecturer as regards the identification and implementation of appropriate technology (to solve the needs of the SMEs). Relevant education and training, along with adequate capabilities of the CoET staff (students and lecturers) were also positively impacting on the technology transfer, as well as R&D performed by the students in cooperation with their supervisors for the specific project that was designed.

In most cases, the technology transfer via student projects is a two way transfer in the sense that SMEs have often been approaching TDTC

with a specific problem for which they needed technical solutions that TDTC could develop. It has not been two way in the sense of transferring technological knowledge from the SMEs to TDTC, but in the sense of transferring business needs and technical needs to TDTC, which in different contexts during the interviews has been stressed as very crucial as any feedback from SMEs is very limited.

Importantly, the technology transfer would not have been possible without the financial support of TGT, which is a crucial additional enabler that was not specified in the literature presented in earlier chapters in this thesis.

The following figure 5 illustrates the enabling elements of the technology transfer mechanism in the form of student projects. To illustrate the enablers, the figure is based on figure 1 describing the critical factors for successful technology transfer and on figure 2 illustrating the specific knowledge flows that can be embedded in the technology transfer process. The below figure thus sums up the specific elements involved in this transfer mechanism as presented in this section.

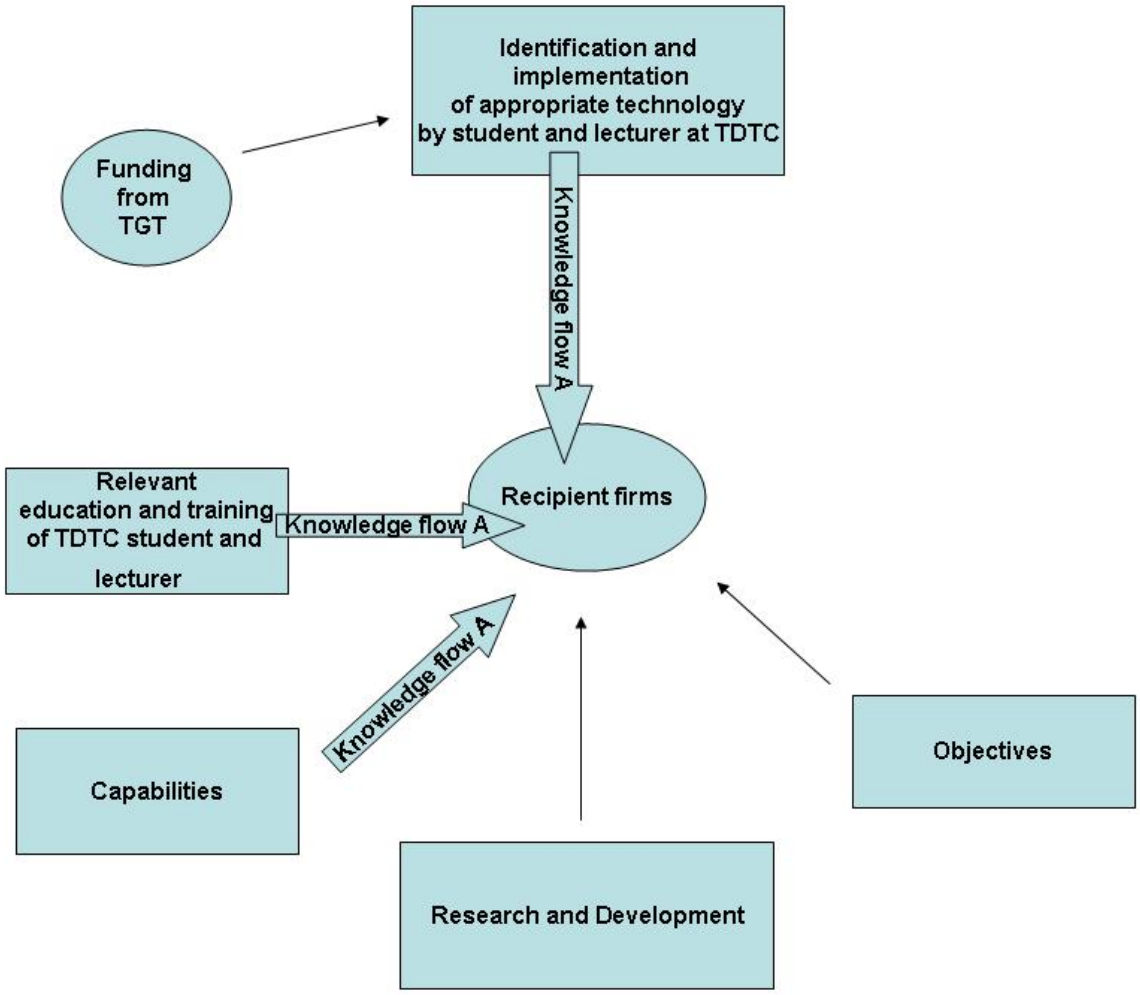


Figure 6: Enabling factors in the student project technology transfer mechanism
Source: own draft inspired by Madu (1989:120) and Bell (1987:14)

7.4.4 SME incubator programme – "incubator without walls"

The first technology transfer instrument that was implemented in the TGT-CoET collaboration was the incubator programme[35] (coordinator,

35 The business/technology incubation program in its very early start phase/pilot phase was co-financed by TGT, the Carnegie Foundation of New York and the Tanzanian Government through the University of Dar es Salaam. If the three pilot areas are successful, the aim is to develop the project into a platform and implement a nationwide National Incubator Program (NBIP) as part of the National SME Development Policy (2003).

external links, CoET-UDSM, 2009), and this also constitutes the largest project in the TGT-CoET collaboration, which started in January 2006.

According to the coordinator of CoET's external links, the idea with the incubator program was to adopt the concept as much as possible to the local needs. He explains this by stating that there are different types of possible incubator programs.

> *"Incubation of course can be….[…] with walls where you can have buildings, you can put the entrepreneurs together there and try to nurture them and after that you chase them out to start their own business. The other way is to have them where they are, that is incubator without walls, so whatever they are doing there, whatever they are producing, we just try to mentor them… make sure their business is growing, so we looked at both and because of the funding needed for the incubator… then that was impossible for us to start. So what we started was incubator without walls. That is, try to maintain the clients where they are and just go there to advise them from time to time". (coordinator of external links, CoET-UDSM 2009).*

As of today, there are three pilot incubator centres. One is in Kibaha, which is about 40 km from Dar es Salaam, there is one in Morogoro, 200 km from Dar es Salaam and the last centre is in Lushoto about 600 km from Dar es Salaam. These centres now have a large group of entrepreneurs. These are mainly working on agro-based products, processing fruits, vegetables, processing cheese and butter, etc. The Kibabaha incubation project has circa 4,500 clients. These are working in about 37 groups. In Lushoto, there are close to 32 groups and in Morogoro around 19 groups.

The incubators are all addressing local economic development related problems that aim to improve the entrepreneurial competence in particular in the area of food processing.

The **Kibaha** Business Incubator is a "hybrid incubator" – a combination of "incubator with walls" and "incubator without walls". There are 26 groups/firms which are divided into four processing categories: Cashew Nut Processing, Cassava Processing, Fruit and Vegetable Processing and Dairy Products Processing.

In **Morogoro** there is an "incubator without walls" implemented. There are in total 19 entrepreneurs and all of them are small enterprises or comprised of groups with less than ten members. These deal with processing of fruits and vegetables into wine, juice, jam, pastes, pickles and dried products, dairy processing, mushroom production and processing, soy processing, honey production and processing, poultry processing.

The incubator in **Lushoto** is also without walls. This incubator has a total of 13 groups. All of them are groups or cooperative societies with members ranging from 10 to 126. Their businesses include fruit and vegetable processing into juice, jam, pickle. They also process dairy products such as fresh milk, yoghurt and cheese. Potatoes are grown and sold as well as a range of other vegetables. Baking belongs to the business activities. Furthermore, fruits, vegetables and spices are dried.

The procedure of CoET in choosing SMEs that can participate in the program and assisting them in their business development has been described as follows: CoET sets entry criteria regarding who should be taken into the incubator programme, this covers crucial issues of looking at the history of the production process of the entrepreneur, examining who has a good idea and which idea has prospect for growth.

Subsequently, the entrepreneurs are offered a wide range of subsidised facilities and services such as entrepreneurship training, good manufacturing practice and record keeping through key staff employed for this, common (shared) administrative services, hands-on enterprise counselling, specialist advice/external networking, information assistance to access markets and access to finance/loans. Within the training offers, main areas are for instance processing of cassava, vegetables, fruits and cashew nuts. The equipment for the cassava processing was provided through TDTC. A cashew nut processing plant has been established in Kibaha at a central facility that covers all clients engaged in cashew nut processing. In Kibaha, 90% of all crops that are sold on the market is cashew nuts. Also in Tanga, equipment for cashew nut processing has been installed.

Other training includes specific issues on the production and processing of the above described resources. For examples, most fruits are lost

during the harvest, but in particular in post-harvest for example during the transport to Dar es Salaam. Another problem is packaging. In the incubation it is taught how the packaging can be improved so that the products are not damaged.

Thus, CoET starts to follow each group individually depending on the production process and then offers further training which focuses on specific areas of business, food processing, etc., so that the quality of their products can be improved.

According to the coordinator of CoET's external links, another crucial aspect of the collaboration is that they are trying to convince the members to register, i.e. formalize their businesses. Dr. Temus stressed that this is supposed to be the responsibility of the government, but they are also assisting in this and informing all participants in the incubator program of the advantages of registering.

As a result of this, according to him, some of the firms have started to register their business. CoET aims to connect the firms with the financial institutions so that they can start getting credit.

However, as interviews with some participating firms revealed, this process is not as straightforward as it may appear. It is a long and complicated, time-consuming and expensive process as those involved in it reported.

Project 1: Wine clarification

> *"When you make wine, sometimes you might find some particles in it, sediments, so some study was done here to make sure it is filtered properly and the right chemicals to make sure they can settle. This is now also used somewhere in Kibaha. There are two entrepreneurs who are part of our incubation programme so there are incubator plans and they are using student project products to make sure they get better quality products"(Coordinator, external links, CoET-UDSM 2009).*

The following project started as a student project and was then transferred to the incubation program for a more extensive follow-up and production, introducing several entrepreneurs to this new technique.

Project 2: Solar drying of vegetables

In Kibaha

> *"We developed some solar driers and they have been tried there and the scale has been improving depending on the market, and currently the newest drier which we are about to make is with a capacity of about 500 kilos of fruits that is still under construction because after the students have done basic studies and made the design, then the manufacturing is not part of the students project because that needs money. That is under construction. With that kind of a drier even other students are going there to take data to just follow up whether the drier is still performing the way it is supposed to and advise the entrepreneur from time to time"(Coordinator, external links, CoET-UDSM, 2009).*

7.4.5 Enablers

Enabling factors for the technology transfer process via the incubation program were the identification of appropriate technology and capabilities of the CoET personnel carrying out the training of the firm employees in the incubator programme. Clear objectives have been further enablers. Contrary to the student projects, the entrepreneurs in the incubator programme have the possibility to receive more comprehensive teaching of relevant tacit knowledge about, for instance, the new production techniques as they are "supervised" during a longer period of time and until they are able to proceed on their own. This is not possible to the same extent in connection with the student projects. As in the student projects, training is provided, however, mostly in connection with bringing the newly developed prototype to the firm and installing it and explaining how it works. This introduction to the new machine is much more limited in terms of time, as compared to the longer and much more comprehensive training that is offered to entrepreneurs in the incubator program.

A further crucial element was the funding provided from TGT through the TGT/CoET collaboration as well as the training that is offered. These are additional elements that are added to the following figure 6 that otherwise uses the relevant elements of figure 1 presented in the theoretical chapter of this thesis, with specifications of the different knowledge flows. As opposed to the student projects, here it was possible to also identify knowledge flows of the B-type with its stronger emphasis on using and transferring human resources during the acquisition process. Still, even within this level, the capabilities that are acquired are on basic and intermediate levels. An important distinction to the model presented in the theoretical section on critical factors for successful technology transfer is the additional elements that are needed for successful technology transfer to informal firms.

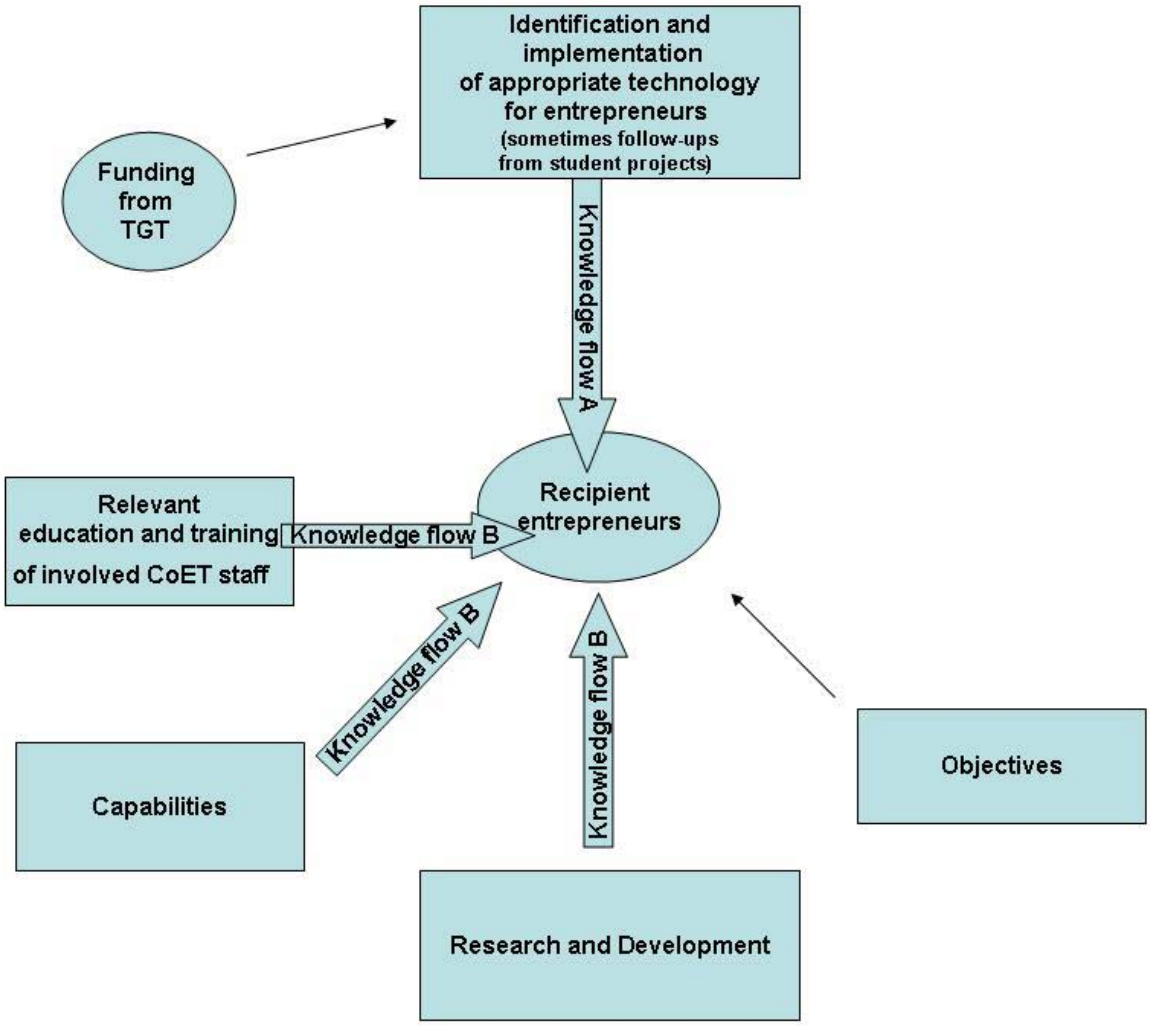


Figure 7: Enabling factors in the incubator technology transfer mechanism
Source: own draft inspired by Madu (1989:120) and Bell (1987:14)

7.4.6 SME Gatsby Clubs

As the number of SMEs that needs assistance and support in various ways (as the initial survey has revealed) is large, the Gatsby Club mechanism offered an alternative or complement to the incubator program in which only a limited number in a few selected localities could participate. Through the Gatsby Club, the services offered to the SMEs could also be expanded and was a way to reach firms in the informal economy. In addition to this, a crucial extra dimension is the facilitation of increased networking opportunities for Gatsby Club members.

All in all, there are six Gatsby Clubs in Tanzania. There are four in the Mwanza region and two in the Tabora region.

In Mwanza city, there are the Nyamagana Club and the Ilemela Club. Nyamagana and Ilemela are two different districts in Mwanza so one club in each district. In Sengerama district, there is the Sengerema Gatsby Club. This is the biggest club with about 150 members. The clubs in Mwanza, Nyamagana and Ilemela have about 20 members each. Nyamagana has 25 and Ilemela about 20. The Nzega Gatsby club is in the Tabora region; it has 18 entrepreneurs. There is another Club in Tabora called Sikonge Gatsby Club, and there was another one earlier; but these have been merged with the Sikonge Gatsby Club.

According to the coordinator of CoET's external links, the overall idea with the clubs is the following:

> *"A club is…it is not like a football club. It is that people interested in one thing they come together, they might have different types of businesses but they have sort of common interest that is when they come together they can find a market together, sometimes if they want to promote their things, they can think of doing that together always, they share some of the costs and sometimes it becomes some kind of social gathering where they can talk about other things besides their businesses. So for them, the way they are….right now they 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. That is where they are really making the products" (Coordinator, external links, CoET-UDSM, 2009).*

The showroom is open 24 hours during the working days, and besides the showroom, Gatsby Club members can also participate in exhibitions. If there is a trade fair somewhere, the members organize themselves and send one representative with different products for marketing. Since they are working together, they can contact CoET or TGT as a group, but not as an individual, if they need for example financial or technical assistance.

It is also easier to organize training for a group rather than an individual.

According to the informal firms interviewed, they have had several benefits by joining Gatsby Club:

- Financial support from TGT
- Regular access to workshops and trade fairs (which based on the survey analysis showed to be a crucial knowledge source)
- Received an email address
- Easier access through new facilities.

These are important infrastructural conditions that are favoring an innovation enabling environment.

It was new to CoET to test how the management worked from the distance, which required new managerial organizations as the Gatsby Clubs are located where the firms are located (rural areas). In practice this basically meant to employ one person as a coordinator. This person is based in Mwanza and moves around to the clubs and gives feedback to the university. In addition to this, from time to time CoET employees go to Mwanza and check the work. The financial consequence of this distance management is clear. Managing these clubs is more expensive than managing the incubator which is 40 km from CoET in Dar es Salaam.

The intention to start the Gatsby Clubs far away was also to gather the experience regarding whether such activities coordinated by CoET can easily be moved around the whole country. It was stated by CoET that it is not an easy task.

The course list offered through the training encompassed the following: Networking with service providers, problem identification and solving, TGT's financial services, technology services offered by CoET, Entrepreneurship, Entrepreneurs' rights and advocacy, Marketing, Business Planning, Management of small businesses, resource mobilization, record keeping and quality assurance.

7.4.7 Obstacles

The clubs usually call themselves only Gatsby Clubs, not Tanzania Gatsby Clubs. The name is basically only in order for them to identify themselves with TGT since it is their main funder and therefore it was good for marketing reasons. That this distinction is not always quite clear was vivid from much of the correspondence in connection with the questionnaire to be filled in for the survey. It turned out that some of the firms belong to the Club, use the facilities and the infrastructural benefits such as email address, but they have not been able to attract further funding for their business and are not officially a member of the TGT club.

Ideally, also firms in the Gatsby Clubs should frequently receive assistance through student projects. So far the clubs have not benefited from this, but it has been promised for the future. The main reason for this is that Mwanza is too far from Dar es Salaam; with the student projects the key idea is that the student must be able to visit the firm and see what is happening on the ground and based on that develop a prototype or a business idea. Mwanza is too far away for this, and students' projects are therefore based in Dar es Salaam and Kibaha.

Because of these constraints, CoET staff that is involved in this collaboration is considering to expand the benefits of student projects to Gatsby Club SMEs by trying to transfer say machines as well to SMEs that are part of the clubs.

In order to do this, a comprehensive database would be needed, and last year CoET therefore started to compile a sort of survey of the SMEs they have currently, including the incubators, the club and also the clusters. CoET then tried to list the kind of problems that they could possibly have, and the possible student projects which could be initiated to address these problems. The list included to around 100 projects.

The yet unsolved question is who will fund all these projects that would link the student projects with the various SMEs in the different CoET initiatives. TGT was also very interested in and supportive of the collection of this overview as they expressed the domination of SMEs as regards general collaboration throughout the different initiatives and transfer mechanisms and comparatively less student projects.

The summarizing reflections and figure regarding the enablers of the technology transfer via Gatsby Clubs are presented at the end of chapter eight – after the in-depth elaboration of the different elements impacting on the successful technology transfer via Gatsby Clubs, as some of the enabling factors are discussed and analyzed in that chapter.

7.5 Summarizing reflections on the technology transfer mechanisms

While the transfer of technology from CoET to various types of SMEs and entrepreneurs may appear quite comprehensive, covering a range of mechanisms as well as industrial areas and business operations, it was stressed extensively that there appears to be basically no link back from the informal "industry" to the university. This is not equally the case with the well established formal industry with larger enterprises.

It was highlighted that this lack of feedback and approaching CoET for advice is not a result of lack of interest, but rather lack of information about their services and prototype development. Therefore, it was suggested that it would be of great importance if CoET would be more proactive and visit entrepreneurs in their home places to inform them, for instance, about the whole supply chain of a particular raw product and how new machines can assist in improved production and products.

Despite of the various mechanisms, technology transfer is still rather limited although TDTC is well aware of the firms in need of their technology in the rural area.

> *"We have rice processing technologies and we have maize processing technologies, but the way how to disseminate in the villages, that is the challenge"(Project coordinator, BICO-UDSM 2009).*

An exact reason for this lack of intensified transfer could not be identified. Financing and geographical distance were mentioned as potential explanatory factors. Based on this, it was underlined that a linkage between the university and the "industry" in the informal economy is practically non-existent.

In one of the interviews, this point was very explicitly stated:

> *"Linkages do not exist…. This issue of innovation systems, mapping, making surveys, and writing, it does not work. The department who develops the machine…. It is de-linked from those who own and use the technology… this interactive learning is not taking place. If you do not give me the feedback… make it work and I will see it in the process. For example, the first time I can see it from the catalogue of TDTC…*
> *It would be nice to get feedback from the end user to show this is what I have done from that machine" (Project coordinator, BICO-UDSM).*

Based on these views, it was further stressed that it may be necessary to reflect on different channels of how to transfer technologies to the rural areas and to find new ways of transferring technology. This may be a more complex and encompassing process.

As the project coordinator is reflecting upon:

> *"Maybe you can go as a technology developer to the rural areas and inform farmers and entrepreneurs that some of their activity can be improved through specific machines. But for this, one needs to stay there. Teach them first. Then help in where they can get the credits. Then approach financing persons. Then stay together with these farmers and gradually introduce the technology. That is an intermediation that people are supposed to do, to transfer that technology. Not only to go to trade fairs, or not only to just try to sell it" (Project coordinator, BICO-UDSM).*

Working with firms in the informal economy is difficult in several ways. One of the key problems regarding an assessment of the different technology transfer mechanisms was that these same transfer mechanisms are not applied to all the different firms that CoET and TGT collaborate with. Thus, not all firms that are engaged in the CoET/TGT collaboration are participating in all these various initiatives, but only in some of them.

It is therefore not possible to comprehensively compare the effectiveness of the different technology transfer mechanisms and the impact on the technological capability building, but only to assess them individually.

Still, the extent of involvement and potential impact on capability building is apparent from the interviews that covered the different technology transfer mechanisms.

The technology transfer via Gatsby Clubs is the most complex mechanism and the next chapter is therefore entirely devoted to an assessment of the firms involved in the Sengerema Gatsby Club as well as the type of technological capabilities that have been acquired and how.

8 TECHNOLOGICAL CAPABILITY BUILDING IN SENGEREMA GATSBY CLUB FIRMS

One of the key aspects of this dissertation is to assess the impact or effect of the technology transfer on the capabilities of participating informal firms; that is, how the transferred technological knowledge was used. For doing so, a survey was conducted on firms in the Sengerema Gatsby Club. As described in the methodology section, firms were asked about internal firm capabilities as regards the educational background of the employees and the number of employees.

The main part of the questionnaire focused on the impact of the TGT/CoET –SME collaboration on the technological capabilities that the firms in the Sengerema Gatsby Club had acquired. Through the table with different specified activities that belonged to basic, intermediate or advanced technological capabilities, it was possible to assess both what type of activities the firms were performing as well as which ones were improved or acquired as a result of the collaboration. Furthermore, firms were asked to mark and rank which external knowledge sources were most important to them, as well as name additional organizations that have been important in their efforts to build technological capabilities in connection with the TGT/CoET collaboration, i.e. in cases where additional assistance was needed to follow up on input or assistance received through TGT/CoET.

8.1 Overall analysis of survey findings from Sengerema Gatsby Club

This section starts by describing the main findings of the characteristics of the firms participating in the survey, ranging from information on the educational background of their employees to the industry they work in and important linkages as well as types of technological capabilities that have been acquired as a result of the collaboration.

Through the survey, I have been able to collect detailed company information about the firms in the Gatsby Club which is not available

through public statistics as these firms are not registered. As indicated earlier, TGT-CoET has no database listing all the firms involved in the Gatsby Clubs; this is still under preparation. Thus, the following is based on unique new data.

8.1.1 Firm characteristics

This sub-section provides information about the firms that were surveyed. First some basic numbers and information obtained through the survey are presented and complemented with information gained throughout the interviews.

Overall, only four of the 88 firms included in the sample are family enterprises, which are those listed below. The rest are individual entrepreneurs with employees that are not family members. Apart from the Mama Eliza Tailoring company which is working in the textile sector, the three others belong to the agricultural sector.

Table 13: Family enterprises in Sengerema Gatsby Club

Family enterprises	**Members of family**
Mayengera Investment Company	12
Mama Eliza Tailoring company	3
Asha Agriculture Company	5
Juhudi na Malengo	11
Total	**31**

Source: own survey data

All firms are informal. The manager of the club in Sengerema explained that

> *"there is complication with our legal framework; it is not assisting those small companies. There is a problem with the legal framework and the policy." (Manager, Sengerema Gatsby Club, 2009).*

This was specified further by a UDSM employee:

"For instance, we tried to register some of the small business groups. But we have to pay taxes, the process you are involved in is expensive and time consuming. Sometimes it can take one year until you are registered. That is a problem also.
The registration office is in Dar es Salaam, there is only one. It is called BRELA. So it is expensive to go there from the rural areas" (Researcher, UDSM 2009).

All firms of the survey are located near Lake Victoria in the Sengerema district. It is a hilly area and large district with firms located on land and on small islands.

31 out of the 88 firms in the sample have up to 49 employees, (being a small enterprise) and the rest comprise of up to 9 persons and, hence, classified as micro enterprises. Thus, almost two third of the sample firms are micro enterprises. It was stressed during the interviews that the size of the firm does not indicate whether it is formal or informal; it can have one or one hundred employees and be informal. However, a crucial feature concerning the number of employees is that this is not a number that reflects permanent employees, but needs to be understood as a more loose collection of persons that work together. Thus, the firms mainly consist of a collection of small entrepreneurs that have grouped themselves together according to the main type of industrial activities that they carry out; however, this does not mean that all of the employees of the firm work exclusively in one of the sectors that are covered by these firms.

The following interview excerpts illustrate this very important point:

"The members of our group can make juice, make clothes and also make traditional). drums for the benefit of our group" (Manager, PD Kalangu Medical Store, 2009

"We have some fisherman who bring some fish and process it and pack it and others are dealing with food processing. We do buy some maize, soya beans, etc., so we are in groups. We are sixteen by this time including managing director, manager, food processors and fisherman and people who are dealing with packing"(Manager, Sawanawa Company, 2009).

"We do cooperate, but like I told you each one of us does their own business individually" (Manager, PD Kalangu Medical Store, 2009).

The firms that were surveyed are only firms because individuals have organized themselves in groups in order to attract funding from TGT; therefore they are not only dealing with one type of industrial activity as described on the following page.

Regarding the educational background of the employees, none of the firms has employees with a university degree. 10 out of 88 have one employee, one has two employees and another firm has three employees with six years of high school. Out of the 88 firms, 21 have no employee with a three year high school education; most of the other firms have 1 – 2 employees with this educational background. Some employees have technical education.

Most of the firms have been established throughout the past 8 years, only very few firms have already existed for a long time. The survey is thus comprised of rather young firms. A detailed overview for the year of establishment for all the firms in the sample is presented in the table below.

Table 14: Year of establishment of surveyed firms

Total Sample	Category	Frequency	Percentage
N=88	1985	1	1.1
	1987	1	1.1
	1995	1	1.1
	1996	2	2.2
	1997	1	1.1
	1996	2	2.2
	2000	5	5.7
	2001	7	8.0

	2002	13	14.8
	2003	16	18.2
	2004	12	13.6
	2005	13	14.8
	2006	14	15.9
	Total	88	100

Source: own survey data

These firms are working in different sectors. As explained in the method section, the different industrial activities were classified into respective industrial categories, which are agriculture, food processing, textile, tool making, health services, construction, fishing, carving, carpentry and salon. As mentioned in the method chapter, it is, however, necessary to be aware of this sectoral belonging not always – rather rarely in fact – being fixed or assured for a long time. This realization, together with information concerning the number of employees, revealed difficulties concerning the application of the whole concept of "firm". The following excerpts from interviews may illustrate this further:

> *"I use a milling machine as well as grow tree seedlings as well as lay bricks" (Manager, PD Kalangu Medical Store, 2009).*
>
> *"Because we have a small shop of drugs and also we are making drums, (traditional drums). So we are working closely with our client and also competitors in order to sell the product in good quality"(Manager, PD Kalangu Medical Store, 2009).*
>
> *"They give me loans which helped me to start a new business of selling rice apart from growing vegetables which help me have more income as the profit"(Manager, Marium Kilimo, 2009).*

A number of sub-channels or specific instruments have been implemented as part of the technology transfer mechanism in Gatsby Clubs. These are in particular the various training programmes that are

offered to Gatsby Club members and also to clients in the incubator programme.

8.1.2 Main added value of joining Sengerema Gatsby Club and specific details

The following paragraphs present the results of the analysis of the survey of answers given in a number of open questions concerning the overall type of benefits from the collaboration and new knowledge that was acquired.

All the interviewed firms stated that a primary incentive or motivation to join Gatsby Club was to improve the economic situation. Several interviewed persons also stated that they preferred and enjoyed to work in groups, and that it was attractive and interesting for them that the loans from TGT-CoET were provided in groups.

The main added value of joining the Sengerema Gatsby Club is summarized below. As these findings show, the most important benefit for the firms was the enhanced sharing of knowledge and skills, which is followed by the improvement of the quantity and quality of products and the identification of proper markets and prices.

40 out of 88 firms stated that they received technical assistance to introduce organizational changes. This was stated to have led to improved job performance due to new business plans and improved management systems. Also, 40 out of 88 firms stated that they received technical assistance for product development.

39 firms stated that they received technical assistance for technological processes and further specified that among others this assistance led to new methods in production (20 firms), improved technical know-how (9 firms) and improved quality and quantity of products (12 firms).

The open answers given in the survey regarding the overall added value of joining Gatsby Club could be grouped as follows:

Table 15: The main added value of the collaboration

	Category	No. of firms
1	Enhance sharing knowledge and skills	51
2	Improve quantity and quality of products	39
3	Identification of proper market and price	26
4	Improve management and job performance	22
5	Improve innovation	10
6	Help to identify competitors	7
7	Increase income generation	7
8	Increase exposure	7
9	Improve workers' relationships	6
10	Acquire capital and loans	3
11	Improve information dissemination	2

Source: own survey data

Following this specification, firms were asked to explain how this new knowledge has further been used. The main results are presented in the table below:

Table 16: Applications of the newly acquired knowledge

	Category	Frequency
1	Increase quality of products	53
2	Exchange knowledge and skills with others	29
3	Get new customers and markets	26
4	Increase production	23
5	Make proper use of products	19
6	Improve machines	15
7	Designing new business plan	12
8	Environment protection	10
9	Innovate	9

Source: own survey data

These summarized answers clearly show that from the view of the firm owners the most crucial impact of joining Gatsby Club has been the

enhanced opportunities for sharing knowledge and skills with different persons, the improvement of the quality and quantity of their products and the identification of markets and prices.

To further specify this particular overall added value, firms were asked in an open question in the survey to write what kind of knowledge was acquired as a result of the collaboration. This information served also as a starting point for choosing firms for interviews to inquire about specific examples concerning the new knowledge.

The by far most important specific knowledge that was acquired led to the improvement of quality product processing, which 65.9% of the survey answered. 51% answered that new methods of production were extremely important.

This rather general summary of the overall findings can be specified by a more detailed analysis. To do so, in the following sections, the answers of the survey combined with interview information are analyzed according to the categories introduced in the analytical framework chapter.

8.2 Acquisition of investment capabilities through technology transfer

The impact of the technology transfer on the investment capabilities of the firms appears to be indirect. Importantly, as shown in table 15 on the main added value of the collaboration, only three firms specified the acquisition of loans and capital as main added value.

Investment capabilities can be differentiated in two dimensions; they consist of: a) the ability to diagnose their technological needs and to prepare a funding project, i.e. how to apply for funding and b) the ability to attract further funding.

If by investment capabilities we understand the ability of the firms to identify their technological needs as well as the investment needed to

meet those needs, then we can conclude that the technology transfer had very limited impact on the acquisition of investment capabilities.

8.2.1 Ability to diagnose technological needs

The received financial support is not used in a way to expand the production in highly fancy ways – at least not from the empirical evidence collected – but is more about securing basic technology that a) makes production both somewhat easier and faster and produces an improved quality of the product and b) is used for long-term goals as the loans are usually too small for this.

A crucial point is furthermore that those who received funds or loans need training on how to spend the money. This was underlined in several instances and very clearly expressed in the following excerpt of an interview with the Gatsby Club manager:

> *"People are sometimes just given money, but they do not know how to spend it. Or sometimes they have products, but they do not have a market. Sometimes the people in the village told me that they do not need money. They maybe need a lodge. If somebody does not explain how to spend that money it can be difficult. Infrastructure is needed. Some of our groups they did not know how to spend the money, they said I did not get anything apart from the money"(Manager, Mayengera Investments Company).*

Part of training in investment capability building is hence connected to working with the entrepreneurs on priorities for particular projects. If a firm is applying for loans, it needs to specify what kind of project is suitable to be performed with the allocated amount of money. Through the Gatsby Clubs, one of the specific training sessions is on business planning; in this module, part of the teaching is about how and for what purposes the specific money can be spent.

The Sengermea Gatsby Clubs manager further emphasized that:

"So we needed to recommend to TGT that funds are not the only thing that can promote the informal sector, but training is very important" (Byoma, 2009).

8.2.2 Ability to attract further funding

Importantly, in addition to the loans provided by TGT and CoET, CoET employees are actively trying to assist Gatsby Club members in the process of attracting additional funding from other sources, which is another important capability in this category. This is crucial, and all the earlier described firm characteristics need to be kept in mind when trying to understand and analyze the realities one faces when it comes to receiving and applying financial support by informal firms, with small scale activities and various, changing types of industrial activity.

Receiving loans has been the most important incentive for firms to go through the long process of registering their business. Hence, CoET shows from which institutions loans can be obtained and often, as people need capital to start their business or continue and expand it, the process of formalization is started. A challenge is, though, that most firms have only been able to attract small amounts because they have to show that they can produce more before a bigger amount of money is provided.

Related to the ability to attract further funding is the need to formalize business activities. CoET assists in this process for instance by providing detailed information regarding the requirements for formalizing a business. In addition to informing the enterprises, they are also in contact with banks and other microfinance institutions.

There exists a specific program for formalizing the property and business in Tanzania which is called MKURABITA. It is a strategy for formalizing all informal businesses in the country, independently of "whether they are nine or hundred persons they are not registered. And we have big firms which are not registered because in the past I think it was very difficult to register some of these things and when the system is not working properly people say why waste my time? So they were not registering, they can do their business, they sell, they get money so the government was losing a lot of money. So this strategy came up in order

to make sure they register (….)" (CoET coordinator, external links, 2009).

However, the issue of formalization is a complicated issue. For instance, corruption is a very frequent problem in this area – as in many others. It was stressed as a fundamental problem in the country. This was illustrated by an interviewee:

> … *"because if you do not give money to the officials working in the registration office, in BRELA, then you cannot get the registration. Yes, you have to give them some money to process your case. So corruption is a big problem making these things not working properly. There is a very large percentage of people employed in the informal economy, but this issue is not addressed. It generates income for so many, etc., but it is difficult to understand how the sector works. Even to get loans, to register you have to pay them, just in order to process… It is usually around 10%, it is a common thing now. That is why it is a problem. So even then you have to give away parts of your loan" (Manager, Sengerema Gatsby Club, 2009).*

Furthermore, as was illustrated at the beginning of the thesis in the chapter on informal economy, in addition to the costs, registration is a highly time consuming process, which was also explained by interviewees, as for instance:

> "*It is not only that our colleagues… if you have a simple business… you need even a registration for the land… but when you go to the office to register that land, it is a long process that people do not have the time for… The other thing is that people are not aware of where they can get the information. Where to get information in the market, where to get loans. There is a missing link. A lot of information they are not having it"(UDSM employee, 2009).*

The issue of training also matters in formalizing issues as it is not only related to information regarding where to register the business, but the formalization procedures also require an evaluation report each year which needs to be brought to BRELA. Hence, again someone needs to be trained in producing an evaluation report.

This is also confirmed by the manager of the clubs in the Sengerema district.

> *"Actually the main reason to start our clubs, our institution or groups was to have a fund that will rotate so that we can help each other. We did not know that there was TGT when TGT came we learned that they have some funds" (Manager, Sengerema Gatsby Club, 2009).*

Thus, a very crucial result of joining Gatsby Club is in terms of investment capabilities. This is for many firms a very crucial source of local loan, with which the business of individual members in the club can be supported.

> *"Our district agriculture office gives us technical advice, but they do not help us in capacity building. For example, they cannot help you improve your farming like help you expand your farm, lets say when you want to move from 10 to 20 acres. But if you are a member of Gatsby, they give you a loan to enable you to buy farm implements" (Manager, Mayengera Investments Company).*

The way soft loans are provided via CoET is for example that they give machines on loan basis to Gatsby Club members. So for example

> "*if one wants to make peanut butter, we can just fabricate that in our workshop here, we give them to the entrepreneur then they can pay back slowly, while he or she is trying to get a loan somewhere else. So we are providing soft loans in a way" (Coordinator, external links TDTC, 2009).*

Investment capabilities and production capabilities appear to be closely linked to each other. For example, a firm manager explained that he is harvesting rice now. Someone from Gatsby Club has advised him to give some money (down payment) in order to get farm implements to help in farming which reduces the burden of cultivating.

It was illustrated that the advice on attracting soft loans from CoET may have a direct impact on his production capabilities and reduced burden of work. For instance, Gatsby Club trainers have suggested to selected individuals to apply for loans and to buy a tractor in turn.

Thus, what all the above discussion on attracting further money as well as formalizing the business shows is that it is time consuming and not solved by merely informing persons about the benefits of formalizing as these are entirely new issues. Firms may have been little exposed to the use of money and even less so to the long and complicated procedure of formalizing one's business. It is therefore not merely a flow A type of transfer, as described in the analytical framework chapter and illustrated in figure 2 in that chapter, but it incorporates extensive training and learning processes that are provided through one or several transferors. It can even include knowledge flows of the C type in cases where the transferred content, for instance on the use of money, has contributed to creatively further develop the production by for instance changing the production process. Again, we are dealing with informal businesses that operate on a small scale, and changes in the production process could possibly be a tractor that could be hired and increase the sales due to the fastened harvesting options. In a sense, it can be defined as an in-house process innovation as it is new to the firm. This illustrates the difficulty with adopting the categories to informal firms, as the definitions that can be made are very different from those of more formal or other developing country contexts a little higher up on the development ladder. Thus, what could be added to the figure by Lall (1992) is financial training and formalization training.

8.3 Production capabilities

As the survey results revealed, the firms indicate that production capabilities have been significantly improved as a result of their participation in technology transfer with CoET. In the analytical framework, it was discussed that production capabilities refer to knowledge and skills that are necessary to operate a plant and encompass production engineering, production management and repair and maintenance.

However, in order to understand what a significant improvement in production capabilities means, one needs a better understanding of the type of production activities that were specified by the firms.

8.3.1 Type of production activities in Sengerema Gatsby Club firms

All production is small scale. The various firms deal with a range of different activities, as was described earlier. The main agricultural activity is lifestock keeping (cattle, pigs, cows, goats, donkeys, etc.) and crops growing (in particular maize, rice, potatos, banana, cotton, cassava, beans, soya beans). Production activities also include the production of local stoves. It further includes some processing like the production of jam, wine and juices.

Importantly, the activities specified in the survey were categorized as industrial belongings, but take place on a small scale. The level of e.g. textile in Sengerema does not constitute a real textile industry, but there are informal enterprises who are working with textile. According to one interviewer's view, it is all a matter of classification as there are many different products that are produced of textile in Sengerema, ranging from shoes to clothes of very different types to different utilities in cars and motorbikes and balls for children to play with. Hence, it is not an industry in a well established, mass producing sense, but small scale and entrepreneurial activities with an emerging structure of client, customer, competitor and financer interactions through the infrastructure provided through Gatsby.

In connection with production capabilities and as a separate question in the survey, firms were asked if they had received technical assistance to improve their working tool/machines or even received new machines after they joined Gatsby Club. Approximately half of the participants in the survey had received technical assistance while the other half had not.

Those who had not received that type of assistance pointed out that this may be due to the fact that they do not possess any modern working tools, but expressed optimism that this will change once they have the possibility to access more modern working tools. Likewise, the lack of tools and technology was pointed out as a hinder for increased production. One interviewee specified

> *"I would need a machine for grinding large stones from pebbles and one for sieving. Also, I need a means of transportation, which would help to transfer*

large stones from the site and bring them to home. That would improve the performance of my work" (Manager Marium Kilimo, 2009).

Positive answers were given as a result of various types of assistance. For instance, an increase in the production could be stated by several firms. One interviewee specified that he cultivated five acres of rice and harvested 150 sacks of rice instead of the usual 20 to 30 sacks he used to harvest before joining Gatsby club. Someone else explained that he was introduced to a chemical insect spray that killed weeds which helped to reduce costs to weed at the farm and thereby significantly reduced production costs.

Another striking factor in connection with results for the production capability was that many firms stated that they have diversified their production into several different products, not only within their same "industry" branch, say e.g. diversified products from textile, but instead across industrial activities. This is illustrated in some of the examples taken from the following interviews:

"I have learned about how to keep a good environment while we are producing and how to make things in a clean way" (Manager, Mbawala Food Processor, 2009).

"A main improvement in our production is that we are now producing more than one product because we are divided in groups. So sometimes we sit down and arrange who has to produce what and in which quantity according to the demand in the market" (Manager, Mbawala Food Processor, 2009).

"Here we have our production like vegetable, juices, drugs so what we do is to improve the quality in making it and packing it in an attractive way" (Manager, PD Kalangu Medical Store, 2009).

"We were using simple packaging. I think putting it in a plastic bag and putting it into our local shops. We were using transparent plastic package before. As you can now see them on the streets, after the training on how to package, we changed the material that is used for packaging but also the ingredients. So we learned different varieties and can also change the taste now. Maybe for young ones or for sick people or just for ordinary people" (Manager, Sengerema Small Traders Association, 2009).

"So we have different product names now and different variations in the products. The ingredients which are within, they are more varied. And also the expiry dates and the ingredients are now labelled and put outside on the packages" (Manager, Sengerema Small Traders Association, 2009).

Thus, as the above illustrations show, the type of learning that was acquired through the technology transfer varied and covered different levels and activities.

8.3.2 Product and process technological capabilities

A detailed overview of the different, specified activities belonging to the three different levels of basic (B), intermediate (I) and advanced (A) capabilities is presented in the tables below, first showing the number of firms for each activity for the improved or acquired TCs for products and then for processes.

Table 17: Product technological capabilities

Products	Acquired from collaboration	Improved from collaboration
Basic capabilities:		
Replicate fixed specifications and designs	3	31
Introduce minor adaptations to product technology (driven by market needs)	5	53
Conduct routine quality control to maintain standards and specifications	6	77
Intermediate capabilities:		
Introduce new design for manufacturing	3	1
Develop new prototypes	-	10
Improve product quality	13	-
Advanced capabilities:		
R&D into new product generations	3	17
Development of entirely new products or components	1	5
Conduct research into new materials and new specifications	-	2

Source: own survey data

Table 18: Process technological capabilities

Processes	Acquired from collaboration	Improved from collaboration
Basic capabilities:		
B: Assemble components and final goods	2	19
B: Introduce minor changes to process technology to adopt it to local conditions	6	55
B: Maintain the machinery and equipment	2	27
B: Introduce planning and control of production	5	48
B: Improve efficiency in existing work tasks	2	71
Intermediate capabilities:		
I: Manufacture components	2	11
I: Improvement of layout	2	19
I: Introduce automation of processes	-	1
I: Select technology	2	4
I: Obtain an International certification	1	2
Advanced capabilities:		
A: Perform own-design manufacturing	4	20
A: Introduce major improvements to machinery	-	2
A: Develop new equipment	1	4
A: Develop new production processes	5	11
A: Introduce radical innovations in organisation	2	3

Source: own survey data

The empirical evidence in this dissertation shows how informal firms perceived their own TC building and could demonstrate improvement; however, as regards upgrading, it appears that there is a need to define what upgrading means in an informal, small scale, traditional industries context in Tanzania

The analysis of the survey results shows that most TCs were improved rather than acquired in the context of the collaboration. This applies for both product and process TCs.

In total, most TCs have been improved on the **basic level**. For product related TCs, the highest scoring is the conduction of routine quality

control to maintain standards and specifications as 77 of the 88 surveyed firms answered. This is followed by the introduction of minor adaptations to product technology (driven by market needs), improved by 53 of the firms.

For process related TC, the improvement of the efficiency in existing work tasks is the type of TC that has most frequently been improved, which is followed by the introduction of planning and control of production.

Importantly, the amount of firms that have acquired TCs on the basic level is much lower than those that have improved the various activities. For instance, while 77 firms have improved the conduction of routine quality control, only 6 firms have acquired this capability as a result of the technology transfer through Gatsby Club. This applies for all basic level categories.

To illustrate what these activities mean in the context of informal firms, the following answer was provided during an interview on the issue of small adaptation to product technology. As the manager of the PD Kalangu medical store argues,

> *"(…) it depends on the market what you do about the small adaptations. For example here we are in the village so if we are making juice, we buy the bottle for juice keeping, we buy plastic bags and label for our product" (Manager, PD Kalangu Medical Store, 2009).*

Another example is the maintenance of machinery. The manager of Mayengera Investments Company explained that

> *"when we participated in the workshop, we learnt how to control our machine – we are using a small machine for juice making and one for packaging - and how to make good packing and further more want to have consultant who are more experienced to teach us more about food processing, but now we have to learn about market research and all other things concerned with food processing and the quality making"(Manager, Mayengera Investments Company, 2009).*

The adaptations to the product are here – as also confirmed during other interviews – very much related to improving the way the product is packaged and labelled (and thus this also covers other categories of TCs (such as the intermediate process, TC "improvement of layout", but it was provided as an answer to the small adaptations on the product technology itself)).

37 firms out of 88 have improved **intermediate technological** capabilities as a result of the collaboration. Out of these, only seven firms have improved two different types of activities belonging to this category; all remaining firms have only improved one specific activity of this category.

Most of the firms have improved the manufacture of components and the improvement of layout. Only one firm has improved the introduction of automation of processes, and there is also only one firm that has improved its efforts in receiving an international certificate. The selection of technology was improved by 6 firms, and two of them also belonged to one of the first two activities. There is only one firm that actually acquired these capabilities (as opposed to having improved them) as a result of the collaboration.

As regards the findings of impact of the collaboration on product technological capabilities, none was acquired, but all were marked as improved. A large number of firms, in total 76, have marked that they improved a specific type of activity related to product technological capability. 12 firms have improved the introduction of new design for manufacturing, three firms have improved the development of new prototypes, and finally 73 firms stated that they improved their product quality. There is one particular firm that has improved its capabilities in all of these three activities. 10 firms have improved new capabilities in two selected activities at the intermediate level.

During interviews when inquiring about examples of the improvement of the product quality, it was explained that

> "(…) *if you can compare how we have started and where we are right now, you can see that there is the big difference. We are trying to improve the quality of our product. The problem is the capital, if we can get enough*

money to buy machines, we can produce enough in a good quality"(Manager, PD Kalangu Medical Store, 2009).

Another illustration was given on the new design for manufacturing:

> *"Because we have a new sewing machine, we can develop a new style in the clothes and better than it was before"(Manager, PD Kalangu Medical Store, 2009).*

Most firms have improved and acquired **advanced technological capabilities** relating to processes. In total, there are 44 firms who have improved their advanced process technological capabilities, most of them in the performance of own-design manufacturing and the second most in the development of new production processes. Of these firms, there are in total nine firms who have acquired new advanced process technological capabilities as a result of the collaboration.

For the improvement of product related technological capabilities, there were 25 firms in total, and four of them have acquired such new capabilities (these are four out of the same nine firms regarding process technological capabilities; hence, the total amount of firms that have acquired new product and process related technological capabilities are nine).

The following is an example of the machinery improvement which was provided during an interview to provide a more detailed picture of what such an advanced TC really means in this context of informal firms:

> *"For sure they have been helping us a lot and we have improvement in our group; for example through the loan they give us, we were capable of buying a fridge for keeping juice and we bought the sewing machine*" (*Manager, PD Kalangu Medical Store, 2009).*

This example illustrates very clearly that the type of activities are extremely different than what one might expect from answers to these categories.

Another example of the category of advanced TCs of new production processes is the following elaboration from an excerpt of an interview:

> *"Pebbles production begun by making use of my two hands and using a machine to reduce large stones to pebbles. That was the beginning of my business activities before I joined Gatsby club. Then I used my head as a tool for transporting stone/gravel from one place to another. However, through Gatsby we have secured loans, which have made it possible to hire trucks for transporting pebbles from the site to the business centres. Sometimes we use donkeys instead of the trucks"(Manager, Marium Kilimo Company, 2009).*

Another illustration is that of a farmer who stated that he is cultivating cassava and processing flower from cassava. The improvement in terms of new production processes was to learn how to cultivate cassava in an economic way and also to use the cassava by-products, which led to a changed way of production.

Hence, the improved or acquired production capabilities covered basic, intermediate as well as advanced technological capabilities, and the type of knowledge flows that could be identified included all three types of knowledge flows that were described in the analytical framework in chapter 4, flow A, flow B and flow C.

An interesting example is the one of an innovation, the example of local stoves. As the manager of the Sengerema Small Traders Association explains:

> *"They are making local stoves at a low level, we learned it from SIDO. Now it is working as a stove. Is it not using electricity. No, they are using charcoal. The marketing reason was that they use less fire woods. But the real reason was environmental and health reasons" (Mr. Byoma, 2009).*

Another example is the usage of palm oil to make soaps.

8.4 Linkage capabilities

As part of the assessment of the outcome of the collaboration with TGT-CoET, the firms of the Sengerema Gatsby Club were asked whether any other specific organizations have been part of collaborations since they joined the Gatsby Club.

If a mechanism as Gatsby Clubs would function as a platform for stimulating new interactions among different actors by offering some infrastructural support for this, this would have interesting implications also on how to build IS in Tanzania – for instance on the provincial or regional level. Gatsby Clubs or similar associations might have the potential to serve as a kick-off for an IS in different regions.

69 firms have answered yes to the question whether other organizations have been part of the collaboration in the form of technical assistance or other assistance, four have not answered.

Through the answers in the survey, it was possible to identify different types of valuable knowledge as a result of the interaction with other actors. The interview answers in particular stressed the crucial role of training from other actors. The following table summarizes the survey results on this question.

Table 19: Learning outcome as a result of joining Gatsby Club

	Category	Frequency	Percentage
1	New markets	79	89.8
2	New managerial techniques	55	62.5
3	New processes	48	54.5
4	New products or services	46	52.3
5	New technological opportunities	44	50
6	New machinery	12	13.6

Source: own survey data

CoET representatives have been visiting some of the Gatsby Club members to see how the work is coordinated and performed, and it was stated that help was received during such visits. However, apart from these visits and the training courses and workshops that are offered as part of the TGT/CoET collaboration, both in the surveys and the interviews, it was highlighted that many other organizations play crucial roles in various capacity building processes. Some of these organsisations used to be contacted by firms even before they joined Gatsby Club - this was mainly SIDO. Most other organizations were recognized and approached as a result of information obtained through the membership in a Gatsby Club.

The following paragraphs present the linkages that have been built to other actors in the economy as a result of the Gatsby Club transfer mechanism.

The most important organization that has been marked as a crucial source of technological knowledge for the firms is the Small Industries Development Organization (SIDO) mentioned by 46.2% of all firms. This is followed by Sengerema Non-Governmental Network (SENGONET) with 23.1% and by Tanzania Chamber of Commerce, Industry and Agriculture (TCCIA) with 19.2%. A few additional organizations have been specified by some firms. This was Delaware College of Art and Design (DCAD) with 9.1%, Tanzania Industrial Research and Development Organisation (TIRDO) with 6.8% and finally UAI with 3.4% and the Food and Agriculture Organisation (FAO) with 2.3%.

SENGONET is a network within the district; it works with organisations (NGOs), Faith Organisations and its main objective is to connect these non-governmental NGOs, CDOs and other institutions to provide donors access to them.

Thus, they work with the Community Based Organisations (CDOs) of the farmers, NGOS of the farmers; it does not work with an individual person. For example, TCCIA helps the farmers, but in order for those farmers to be accessible to other external helpers, they need to be organized or connected to a group. This is possible through SENGONET in order to get that external assistance.

Many of the increased linkages to various types of actors have also had an impact on increased production. For example, information has been provided on where to buy seeds, farm implements, how to prepare the farm, etc., and also where firms can receive even more specified advice.

> *"We get advice from the district agriculture office on how to improve our farming. For example, they advise us on rice or cotton farming. I grow rice, cotton and recently jatropha. I recently started jatropha farming"(Manager, Lugwakala Farming, 2009).*

Increased exposure to a more diversified number of different actors was explained to result from the increased infrastructure that Gatsby Clubs are offering, for instance through specific showrooms. This has enabled clients to present their products and led to a larger range of customers. One interviewee explained that before he joined Gatsby and used the opportunity of showrooms he had "*to go around the street and look for the customer*" (ibid).

Excerpts from interviews:

> *"We do not have competitors. We just struggle to improve agriculture. We only exchange ideas. Competition here is all about struggling to share information with fellow farmers in a bid to improve agriculture" (Manager, Endeleza Mazingira Kome Enterprise, 2009).*

> *"Our skills and practices do not change from A to B to C, this thing requires and depends on several factors. We got some assistance from TGT. Mainly financial assistance, with that of course we changed something. But during that time, then there were also others who helped to change something. But without that money, it is not possible to change anything. So that money helped a lot" (Manager, Sengerema Small Traders Association, 2009).*

SIDO has played a crucial role which was stressed by almost all firms. SIDO has provided training courses. In particular, food processing was learned through SIDO. Financial assistance for this was received from TGT/CoET and then SIDO came to the area of the firms and taught for about ten days, every month. This was targeted for specific products of crops in the area. Thus, from this training, the firms came to know how to process, and, subsequently, people started to process and package their products.

In the survey, the firms were also asked to mark selected organisations if they cooperated with them and to rank their importance as a knowledge source, by using the scale 5 = very important and 1 = not important. They were also asked to indicate whether the specified knowledge sources are domestic or foreign. If a particular knowledge source has not been used, the firms were asked to leave the row blank. The left hand part of the figure below shows the importance that was given to the

organizations, and the right hand part whether these were local or foreign.

Table 20: Importance of knowledge sources for Sengerema Gatsby Club firms

Knowledge source	5 Very important	4	3	2	1 Not important	Not Answered
Fairs, exhibitions	75	1	2	-	-	10
Chamber of commerce	33	7	3	-	1	41
Competitors	21	17	23	2	1	24
Consultancies of NGO	21	17	9	4	1	36
Clients	19	26	17	5	-	21
Licensing	15	9	18	6	-	40
Consultancies of public R&D	14	7	4	4	1	58
Public research centers	6	1	2	2	-	77
Suppliers equipment & inputs	5	7	1	2	-	73
Universities	3	-	-	2	1	82
Recruitment of highly qualified personnel	-	-	-	-	1	87

Source: own survey data

As the results in the table above show, fairs and exhibition are by far the most important knowledge source for the informal firms with 75 firms (which is 85.2% of the total amount of firms) marking these as very

important. Next on the ranking, are chambers of commerce with 33 firms marking these as very important knowledge sources. This is followed by competitors and consultancies with 21 firms marking these as very important and subsequently follows clients. Only three firms rank the interaction with universities as very important. Almost all these actors are domestic[36].

The most important knowledge sources are fairs and exhibitions. During the interviews, firm managers and employees were asked whether they could further elaborate on what makes fair trades and exhibitions as particularly important.

It was specified that fair trades are crucial as they increase the number of customers. This led to increased sales and increased income. Customers have also provided specific feedback on products which led to improvements of the products. Also, what we could call competitors usually provide very useful feedback for the small entrepreneurs. In this respect, it is also significantly contributing to linkage building with other actors. The impact on the capabilities that are acquired is thus very comprehensive, covering a large set of different capabilities on various levels. Those who did not mark this as important knowledge sources stressed that they did not have money to go to the fairs and exhibitions. Some still benefit when knowledge is shared through those that did attend the fairs and exhibitions.

This information revealed that TGT has often funded the visits to various trade fairs for their members. CoET also explained that they have catalogues of their machines which are distributed on trade fairs and exhibitions. Invitations to the trade fairs are sent out to Gatsby Club members.

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36 In the questionnaire, firms have been asked to only mark the specific knowledge sources if they have used it and then rank it according to its importance, ranging from 5 = very important to 1 = not important. There was also another option to specify NR = not relevant. Thus for matters of clarification, the non-relevant mark above does not mean that the knowledge source has not at all been used.

There is, for instance, an agricultural exhibition that takes place twice a year, but there is a large range of trade fairs and exhibitions. Not only the so-called saba saba in Dar es Salaam, but also other regional trade fairs in the regions. In 2008, some Gatsby Club members went to Kahama and also to Arusha and Mwanza. Hence, there is a range of opportunities.

An interviewee explained:

> *"We learn from agricultural shows. We really learn a lot since there always are many experts there. Even by meeting fellow farmers, talking to them and exchanging ideas. When you ask experts questions at the shows, they answer you professionally such that when you work on the answers they give you, when you apply the expertise, you definitely succeed"(Manager, Sawanawa Food Processors, 2009).*

Once an invitation is received, there are specific procedures within the club to assess which members can show something at the exhibition. Importantly, it was highlighted that:

> *"We have to take something to the trade fair, something to sell and also to bring something back to the club, something you learned. You have something to take to the trade fair, at the same time, when you come back, you have to teach to the other what you have learned – that is our classification, we are not choosing according to industry belonging" (Manager, Sengerema Small Traders Association, 2009).*

Surprisingly, the findings show the extremely limited direct importance of universities as a direct knowledge source. In total, only six firms stated that they used universities as knowledge source during the past years of their operations. Out of these six firms, only three marked that universities were very important. Two more ranked them with "2", indicting very low importance and one specified that universities were not important.

Of course the university is implicitly important as it provides soft loans which lie at the very basis of the operations of these small firms. However, one should not forget that they are provided in groups; the groups then divide the allocated loans further according to the specific needs. Hence, not each and every individual is actually in touch with

university employees when receiving the loans and neither in their continued operations. For instance, not all employees of the firms are participating in the training that is offered by TGT/CoET as part of their collaboration, and therefore a large amount of the different employees in the various informal firms are not participating in any interactions where they meet representatives from CoET.

As quoted earlier, firms perceived that they did not have competitors, and that other firms, groups, individuals with the same or similar products were rather viewed as cooperating persons and called "friends" and "fellows".

NGOs were considered as important knowledge sources as they give consultation of how the small operators can carry on with their small production. Especially TCCIA, TGT, SIDO and PRIVATE SECTOR FOUNDATION were highlighted. It was specified both in interviews and in the survey that many of the firms received their education from SIDO. In particular the food processing short course was re-occurring. For some firms, the knowledge that was taught constitutes their very basic knowledge, without which they could not operate. It was stressed that SIDO offers courses that are free of charge, and therefore these small entrepreneurs tend to make much use of this opportunity.

Thus, the above analysis of the linkage capabilities that have been acquired as a result of joining Gatsby Club is mostly covering a large set of two way sharing of knowledge and exchange of information among suppliers, with competitors and customers, at the basic and intermediate level. It also includes advice and training regarding how to improve specific production aspects. This is mainly occurring via flow A and flow B knowledge transfers. The advanced level could not be identified in the answers that were provided.

In the following figure 7, all the discussed enabling factors of the Gatsby Club technology transfer mechanism are included. As in the figure on student projects and on the incubator program, it thus adds new elements that were identified as crucial enabling factors and specifies what type of knowledge (knowledge flow A, B or C) is transferred.

The square elements are those that are kept from the initial figure that was presented in chapter three on factors for successful technology transfer; the circles are those elements that were identified in the transfer process through the Gatsby Club mechanism. These elements did not appear in the figure taken from the literature, and they are thus added to illustrate crucial additional elements in the transfer of technology to the informal firms in the sample.

An important channel for the transfer of knowledge flow A has been through fair trades and showrooms. Similarly to the student projects and incubator program, knowledge flows A and B have been transferred via the training that has been offered to Gatsby Club members. As opposed to the student projects and the incubator program, in the Gatsby Club mechanism, it was also possible to identify knowledge flows of the C type that lead to the ability to generate technical change. The C type of knowledge flow which includes, as described in the theoretical chapter, the ability to creatively further develop for instance the production facilities or the production process, or changes in the product design; however, also in the organizational structure in the post investment phase of the project. This is a capability that has only been acquired as a result of knowledge C inflows through the Gatsby Club mechanism. It was in particular entailed in the surrounding infrastructure that was provided to firms by joining Gatsby Club. In particular, the additional knowledge sources that they have been introduced to have been important in this respect. An example is SIDO which has played a crucial task in enabling firms to perform production process changes.

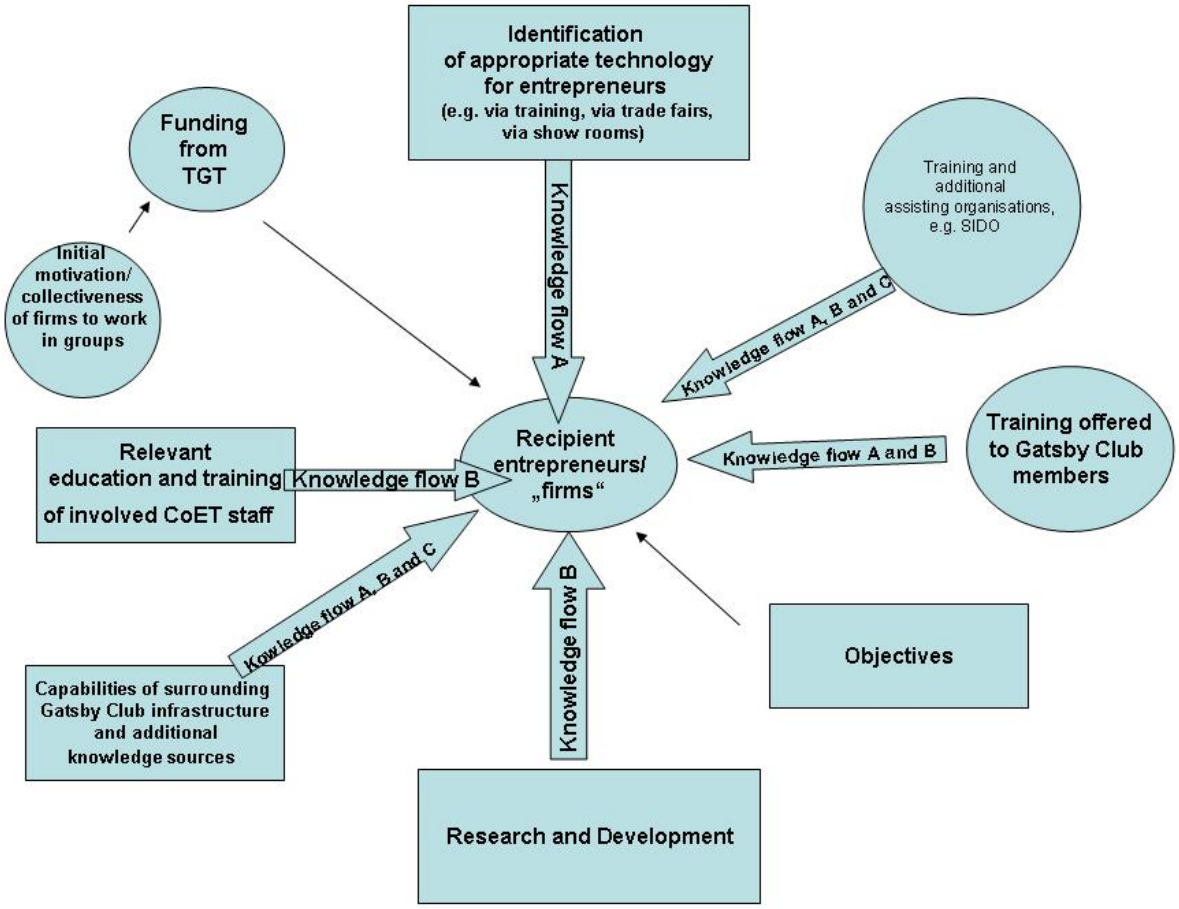

Figure 8: Enabling factors in the Gatsby Club technology transfer mechanism
Source: own draft inspired by Madu (1989:120) and Bell (1987:14)

8.5 Remaining challenges

The aim of the analysis in this dissertation is to provide an account of the technology transfer mechanisms at hand at UDSM/CoET as detailed as possible and analyze its impact on TC building.

The major challenges that enterprises in the informal economy are faced with are specified as lack of or very limited capital/credit, lack of a proper market and/or customers, lack of appropriate equipment and transport problems. Some have also mentioned work permits and strict government regulations when it comes to formalizing their business. Some of these areas could certainly be a case for innovation policy

intervention, for instance to create a set of incentives rather than hurdles in the process of formalization of business activities.

Despite of the positive findings in terms of the theoretical and educational lenses I was applying to the material, there are also less positive answers where the technological capability building effect has been limited. These are illustrated in the interview excerpts below:

> "*In most cases we use cows (ploughs) due to poor agriculture since we do not have enough capital. We do not have the capacity to improve our agriculture though we have enough land" (Manager, Mbawala Food Processor, 2009).*
>
> *"Our biggest challenges are the small capital; if we have enough capital we can buy anything we need for our production and also consultancy" (Manager, Mbawala Food Processor, 2009).*
>
> *"The environment in my agricultural activities. I would succeed if I would get farm implements. Things like a tractor, fertilizer and good seeds" (Manager, Endeleza Mazingira Kome Enterprise, 2009).*
>
> *"And reliable markets. Currently the market for cotton is staggering. There is a very good market for rice"(Manager, Paulo Hotculture, 2009).*
>
> *"There is still no reliable market for Jatropha in our country. It is a kind of agriculture that we can rely on later on so we are still in the preparation stage. You cannot depend on it, like say you would get something out of it in six months or so"(Manager, Marium Kilimo, 2009).*
>
> *"Water pumps are a problem. There are times when we go without rain. If I get equipment to help me water my crops, fellow farmers around me will benefit too as I will share these with them" (Manager, Marium Kilimo, 2009).*

9 DISCUSSION AND CONCLUSIONS

This final chapter is discussing and summing up the main findings with regards to the research questions that were investigated in this thesis and continues with a discussion of the theoretical implications and policy implications of the findings in this dissertation. It ends with some issues that may be interesting to address in future research.

As the vast majority of SMEs in Tanzania are in the informal economy, but still recognized as crucial potential source for economic development and growth in the country, an in-depth understanding of the complexity of their technological learning dynamics is essential. This thesis therefore studied technology transfer from the formal to the informal sphere and TC building in the informal sphere.

The dissertation examined technology transfer mechanisms from the University of Dar es Salaam to informal SMEs in the Sengerema District in Tanzania and investigated the extent of TC building in connection with this. The impact on TC building was in particular studied in detail for one of these transfer mechanisms, namely Gatsby Clubs.

The aim of this dissertation was to answer three main research questions:

- What technology transfer mechanisms exist in the TGT-CoET collaboration?

- What types of technological capabilities have been acquired by informal SMEs as a result of participation in one of the specific technology transfer mechanisms?

- What are the factors facilitating technology transfer to the informal firms?

In order to answer these research questions, an analytical framework derived from theory on technology transfer and technological capability building was developed and presented in chapter four.

The following section discusses the applicability of the framework to the analysis of technology transfer and TC building in informal enterprises in the Sengerema District in Tanzania in the light of a selection of relevant theory and previous results in the field.

9.1 Revisiting university technology transfer in the case of informal firms in Tanzania

Although the conditions of the universities as well as of the firms are highly different in LDCs (e.g. Sagasti, 2004), governments in LDCs are copying policies and programmes to promote technology transfer and university-industry linkages from developed countries (Diyamett, 2008; Kruss and Petersen, 2009). While the field of the entrepreneurial university is rapidly expanding in the developed world and also gradually taking a global outlook (Etzkowitz et al 2009), there is limited material that systematically analyses the role of universities in LDCs. In accordance with suggestions from the South African context (cf. Lorentzen, 2009 b), this study placed the firms at the center of analysis.

Importantly, a large amount of the firms in a country like Tanzania are informal. As the empirical material in this thesis has shown, informal firms may be different from formal firms not only because of its illegal status, low educational background of the employees and difficulties in accessing funding, but particularly also because they are constituted of a loose group of entrepreneurs. This characteristic may have important implications for the conceptualization of the entrepreneurial university in LDCs where technology transfer to firms often goes to informal firms - if universities are to address the needs of this vast majority of firms.

Much of the technology transfer literature has studied how e.g. agent X (the transferor) transfers technology to agent B (the recipient) and specified to what stock of knowledge and technology the transferred technology potentially contributes, e.g. as specified in flows A, B and C where A and B add to the capital goods and C to the technological capacity (e.g. Bell, 1987). It is also acknowledged that even the process from X to Y is highly complex, involving a number of elements such as

e.g. education and training, R&D, capabilities, managerial effectiveness (as was specified in figure 1, adopted from Madu 1989).

Thus, despite these additional factors that are needed for any successful technology transfer project, the process is traditionally mainly seen as a process of exchange and transfer between the transferor and the recipient.

This study has shown that the additional package of mastering technological learning is particularly complex and often stems from a different set of actors, as specified in the previous chapters, and in particular during the discussion on linkage capabilities in the previous chapter. Also, production capabilities were only increased due to increased interactions with other, additional actors. Importantly, the informal firms have been exposed to most of these actors as a result of participation in Gatsby Clubs. In this sense, this transfer mechanism has provided an extremely crucial platform for the further acquisition of TC.

Therefore, in the case of transfer to informal firms, the standard model is difficult to apply without modifications. Before the actual transfer can start, a pre-step is a re-organisation of the small entrepreneurs into groups, requiring a collective spirit to jointly form a "firm" in order to receive funding from TGT in the case of Gatsby Clubs. That is, what in the former model constitutes a firm Y, in the informal economy may be a loose net of individuals working together in a pseudo firm.

Additionally, as the analysis shows, a number of accompanying elements need to be in place in order to make the technology transfer project a success. These additional elements are not only provided through training from the university to the recipients, but additionally from entirely different actors. Thus, the transfer of technology to informal firms is different and more complex in terms of the external organizations that are involved. This is in contrast to studies such as e.g. Siegel (2004 and 2006) and Leong et al. (2008) which instead assume a linear relationship of transfer between distinct organizational actors. However, such arrangement allows for transfer approaches different from what can be identified in this study.

The following figure 9 captures the main building blocks of the technology transfer to the informal firms.

The grey building blocks are similar to those in figure 1 as adopted from Madu (1989) and to varying degrees they could be identified in all the three technology transfer mechanisms, as was discussed in the previous two chapters. The other elements are those that were identified in this study.

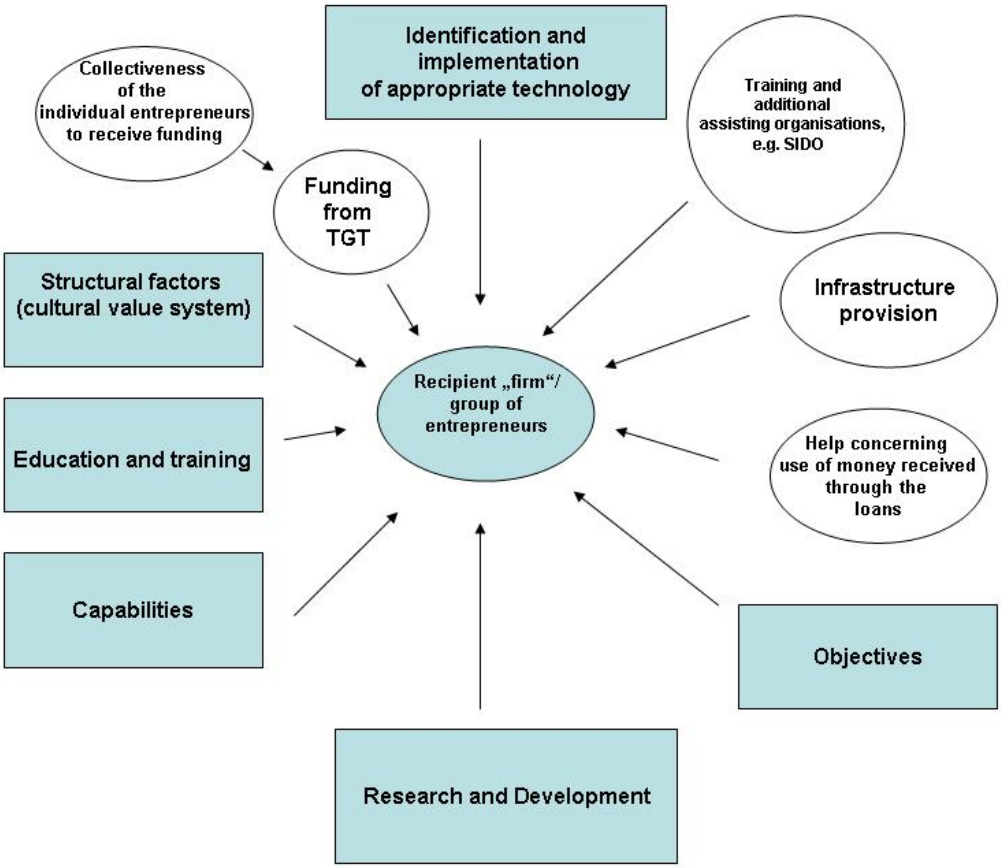

Figure 9: Additional elements in technology transfer to the informal firms
Source: own draft inspired by Madu (1989:120) and Bell (1987:14)

Assisting organizations such as SIDO were very crucial to provide additional training to master the technology that was transferred and the additional distinctive features that enabled the technology transfer process. Importantly, these were not explicitly part of the TGT/CoET collaboration which is in contrast to the views of the critical success

factors for technology transfer as expressed in the overview of Madu (1989). Furthermore, the collective spirit of the individual entrepreneurs has been a highly essential pre-step to the actual transfer process as this was a prerequisite for receiving funding. Moreover, the infrastructure that was provided through showrooms and through email access has also been important as well as guidance and suggestions on the use of money received through the collaboration.

A clear formulation of the problems and needs and hence objectives of the technology transfer has been identified in the context of all three technology transfer mechanisms. Capabilities in the form of human resources and capital were also present in all three mechanisms. Capital is, however, such a fundamental aspect and is specified as an additional factor here and refers to the external funding. To varying degrees, education and training of the entrepreneurs are provided both in the incubator program as well as in Gatsby Clubs. In student projects, it was mainly absent or only very sporadic and for a short time.

In their efforts to transfer technology to the informal firms, universities could explicitly incorporate potential "additional actors" to increase the TCs that can be acquired as a result of the transfer. Given the explicitly stressed weak and even absent feedback mechanisms from the firms back to the university, it could further be beneficial to implement evaluation instruments that would ensure feedback from the recipients of the technology.

9.2 Revisiting technological capability building in the case of informal firms in Tanzania

Drawing on key findings in the TC literature (Lall, 1992; Bell and Pavitt, 1995; Ariffin and Figueiredo, 2003) and the categorization of dividing TCs into basic, intermediate and advanced levels, and grouped into investment, production and capability linkages (Lall, 1992), this study investigated whether and how the derived activities could be improved and acquired in the context of informal firms in Tanzania.

The results of the survey showed that TCs on all levels have been improved and acquired. Notably, to a much larger extent existing TCs

have been improved rather than entirely new acquired as was summarized for each technological activity of the different levels for both products (table 17) as well as for processes (table 18). There is no striking difference between the acquisition of TCs in product versus process technologies; in both cases the improvement is much more frequent than the actual new acquisition. Thus, the empirical results have shown that it is possible to increase TCs in informal firms.

Nonetheless, there are several issues at hand concerning the analytical framework that the literature provides. Firstly, the very basic categories used in the literature do not capture the same reality in the case of informal firms in Tanzania as we would expect and associate with these categories based on studies from developed countries. This was in particular illustrated with interview quotations provided for different activities belonging to the different levels of TC. As opposed to the literature on technological capabilities (Lall, 1992; Bell and Pavitt 1993 and 1995; Padilla-Perez, 2006; Iammarino et al., 2008; Dutrenit, 2004) a critical difference discussed earlier is that we are not dealing with real firms here. Instead what was referred to as firms turned out to be rather loose groups of entrepreneurs. As a consequence, the internal competence of the "firm" is changing constantly, likewise is the industrial belonging; which depends on both market opportunities as well as the competence of the employees, as the empirical material revealed. Thus, even though the focus in the TC literature is explicitly on latecomer firms (e.g. Dutrenit, 2004), informal firms have these distinctive features that would require an explicit focus on entrepreneurs as the unit of analysis.

Secondly, many different hurdles have been mentioned in the pieces of the puzzle of upgrading. It is important to highlight that what an informal entrepreneur understands as advanced capability is most of the time very basic. For example, we need to keep in mind that capacity building in this context may imply to be able to hire a track for transporting pebbles instead of carrying them on one's head!

The main problem in relation to the concept "firm" in this context is related to the findings that we are instead dealing with groups of individuals who mainly for funding purposes have organized themselves into what has been labeled "firm". What appears important in this

respect is much more an individual focus to be integrated in the analytical framework. Even if this appears difficult or impossible, it is a necessity if we are to meet the realities in the informal economy in Tanzania. Thus, much more individual level analysis is required.

The comparatively loose organization of individuals into firms has implications on assessing the internal capabilities as these constantly change and do not contribute to form a firm in the sense that we are used to.

It is certainly interesting and creative to observe how these entrepreneurs have organized themselves in something corresponding to our "firms" – which has been successful for them in terms of attracting funding, but it remains a challenge in terms of the impact of the technology transfer on the firm or rather individual entrepreneur.

The answers provided to questions on production, investment and linkage capabilities showed all that the type of technological capabilities mirrored the very basic, subsistence level of business operations. In most cases, the funds that have been provided through TGT/CoET have enabled the "firms" to diversify their product portfolio and to improve their products. For instance, through the availability of machines, which were purchased from the funds, new designs of clothes or shoes could be made, or better labels for products.

Given the fact that these informal firms consist of a loose group of entrepreneurs and from the analysis of the survey and interview material as presented in the previous chapters, it appears that a crucial step here is the formation of their business, and an important part in this is the formalization of their businesses. This requires a set of technological abilities that firms in the studies in previous theory (e.g. Padilla-Perez, 2006; Iammarino et. al. 2008; Dutrenit, 2004) already possess. To comprehensively assess the set of TCs that may be needed for informal firms to upgrade, a new set of categories may need to be added, for instance one on formalization capabilities. Thus, one may consider additional indicators that can measure relevant TCs in informal firms.

Due to the characteristics of informality and the LDC context in which these firms are operating – the insufficient socio-economic and STI

landscape – the Gatsby Club technology transfer mechanism offers a great spectrum of support to support businesses in their formation phase by providing necessary conditions, such as email access, facilities for showing their products and extensive support to link up with other actors in the economy.

The available framework from the literature on technological capabilities can be adapted to informal firms in Tanzania, even though the answers provided to all the different corresponding activities clearly reflect the different context and are thus slightly different and referring to more basic activities.

Based on the Lall (1992) table that was introduced in chapter three, the following table 10 illustrates a synthesis of the findings of the analysis in the previous chapter by placing the different technology transfer mechanisms that have been studied (student projects, incubator program and Gatsby Clubs) into the respective levels of technological capabilities which were mostly generated as a result of the technology transfer. Thus, the student projects embodied the flow A (as explained in figure 2 in chapter 3) type of knowledge and contributed mainly to the building of basic technological capabilities. In the incubator program, both flow A and flow B were transferred to the entrepreneurs and only the Gatsby Club mechanism also included flow C of technological content.

The following table sums up some of the examples that were provided during the analysis and locates them in the figure adopted from Lall (1992). Following Wei's (1995) suggestion to identify the different knowledge flows A, B and C with the different levels of TCs as differentiated by Lall (1992) (flow A corresponding to basic, flow B to intermediate and flow C to advanced), below this is expanded to the three technology transfer mechanisms that were studied in this thesis.

Thus, as demonstrated in the analysis, student projects incorporated mostly flow A type of knowledge, and, hence, it can be located on the basic level of TC acquisition. The incubator programme also entailed flow B in its knowledge flow and, hence, corresponds to the intermediate level, enabling the recipient to reach a higher efficiency and product quality through assimilating process technology, product technology and production management. Flow C is identified in the Gatsby Club

transfer mechanism and corresponds to the advanced TC level. It offers the most extensive type of technology transfer mechanism, and with respect to the type of TCs that can be acquired, it is the most successful mechanism. Importantly, investment capabilities and linkages capabilities as a result of the technology transfer were only acquired in the Gatsby Club mechanism. Figure 10 below provides some illustrative examples for each category. It is important, however, that these were partly acquired as a result of assistance from external, additional actors and not TGT/CoET. The process is thus even more complex than discussed in the technology transfer literature and illustrated in e.g. Madu (1989).

It is important to stress that these are generalizations that have been made based on the observed examples. They should not be understood as clear-cut, and it is likely that also a student project may allow for knowledge flows of type B in certain cases. It is not very likely, though, that type C would occur. In some instances, it may theoretically be possible that the training in the incubator program is so extensive that during later stages it will allow the entrepreneurs to make changes to the newly acquired knowledge on the production facilities or production processes. It further needs to be reminded that only the Gatsby Club mechanism was studied using the survey with the specific TC questions.

	Technological capabilities acquired			
	Investment	Processes	Products	Linkages
Student projects excludes loans, excludes formalizing efforts excludes training **FLOW A**		coco nut clearing machine	nutrional flour	
Incubators excludes loans, provides facilities excludes formalizing efforts **FLOW B**	pre-planning of projects that could be conducted later	solar drying of vegetables	wine clarification	
Gatsby Clubs **FLOW C**	funds, training in how to use money collective decisions on annual production	milling machine tractors to improve process sewing machine	new design in clothes	SIDO, SENGONET, TCCIA, FAO, TIRDO etc.

Table 21: Types of knowledge flows and examples of acquired technological capabilities

Source: own draft inspired by Lall (1992) and Wei (1995).

9.3 Final reflections and implications for policy

This section intends to open the discussion and expand it from the specific conclusions that could be drawn from the analyzed case material to a somewhat broader level. It also aims to discuss potential policy implications that might be worth reflecting on based on the findings in this dissertation.

The findings of the technology transfer mechanisms and types of TC building as a result of these mechanisms may have implications for the type of policies to be designed. The most referred challenge was the lack of capital and weak linkages. Policy lessons that could be drawn from this are to facilitate different forms for microfinance in Tanzania or create alternative financial incentive instruments. This could be linked to issues of formalization and facilitating the process of formalization as a prerequisite for access to funding and further of capabilities (upgrading of Tanzanian business).

Given the large amount of informality in a country like Tanzania and the associated constraints that this poses, the research in this thesis might contribute to reflect more creatively on distinctive instruments to support SMEs in unlocking their full potential. A particular consideration may here expand reflections on the classical "technology transfer mechanisms" and instead incorporate the whole accompanying and assisting set of actors that are required in order to make the transfer of technology a success.

One observation based on the material in this thesis was that the actual linkage between the university and the firms was rather sporadic and weak, and in the best case scenario a one-way linkage could be observed. Continuous interactions that entail interactive, i.e. mutual learning processes, were more or less absent. This illustrates that in this particular type of constellation of actors in the system, the interactive linkages with feedbacks that also flow back from the end user to the producer (i.e. in this case from the firms to the university) need to be further developed. This is a crucial task for innovation system building, and it would be interesting to see it integrated explicitly in the design of innovation policies. It was also stressed during interviews that more frequent and more comprehensive types of interactions from the university to the

small firms are crucial. The type of interactions could be expanded in order to more broadly disseminate available technology and also to inform about different potential processing alternatives for different raw products in the regions.

The survey results showed that engaging informal SMEs in interactive learning is possible. Firms started entirely new collaborations with different types of actors, such as public research centres, universities, clients, competitors and chambers of commerce and industry associations. Firms were also using consultancies of NGOs and of publicly owned R&D institutes. The most important knowledge sources proved to be fairs and exhibitions. Thus, becoming a member of Gatsby Club opened many new contacts. Gatsby Clubs or similar associations might have the potential to serve as a kick-off for an IS on a regional level and could strategically be addressed for such purposes.

9.4 Boundaries and generalization

The empirical material in this thesis has been collected with purposeful sampling, which means that the material illustrates certain points, but sampling was not done for proportionality. A different set of firms may lead to a different set of findings. The material from the Gatsby Clubs was collected from two clubs in the Sengerema district, assuring 90% coverage in that area, but again the result may be different from another club. Hence, generalizations from this research need to take this into account. More extensive studies encompassing ideally even different countries would therefore be crucial.

9.5 Questions for further research

This dissertation has opened a number of new questions. A general set of questions relates to the extent to which the findings can be generalized to other developing countries, i.e. whether the identified technology transfer mechanisms prove equally important in other groups within Tanzania, in other African countries or other LDCs.

It would therefore be very interesting for future research to design a larger comparative study that analyzes the technology transfer mechanisms and TC building in several developing countries. As the Gatsby Club mechanism was studied in more depth, it would be very interesting to follow up on this and to confirm whether the type of knowledge flows from student flows and the incubator program would also be confirmed according to the type of TC level.

Another set of unanswered questions relates to long term effects of the TC building of the SMEs. In this sense, the information collected in this thesis provides only a snapshot of how the different technology transfer mechanisms supported TC building.

It would be very interesting to compare industry differences as regards the levels of TC building. This was initially an intention, but it proved impossible with the current findings that relate to the flexibility as regards industrial belonging, as specified by the firms.

The issue of formal-informal linkages could be addressed in much more depths along with mechanisms for formalizing informal enterprises and how this relates to upgrading.

The lack of continuous feedback and a true interactive link between the university and firms was continuously stressed. In relation to this, the more active role of intermediate organizations in linking the university more actively to industry needs was addressed with specific reference to TIRDO. This could be more strategically addressed also for innovation policy instruments and would constitute a very interesting angle for future research.

Another interesting venue for future research would be to investigate explicitly the social side of innovations.

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APPENDICES

Appendix 1 - Survey questionnaire English version

LUND UNIVERSITY

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Survey

The aim of this survey is to study the impact of the TGT/CoET collaboration on the adoption and acquisition of technology and knowledge, i.e. capability building in indigenous SMEs. We are also examining the extent to which the acquisition of these new capabilities may have an impact on innovation.

I. COMPANY BACKGROUND

1. **Company name** _____
2. **Year of establishment** _____
3. **Location city** _____
4. **Web site (if available)** _____

5. **To which industry do you belong? (e.g. Construction, textiles, food processing, agriculture…etc.)** _____

6. **Please describe briefly your main activity**

7. **Ownership**

   ☐ Percentage of domestic capital _____%
   ☐ Percentage of foreign capital _____%

8. **Is your firm a family enterprise?** ☐ Yes ☐ No

   If yes, how many members of your family are working for your firm?_____

9. **Number of employees (average full-time equivalent for 2007)**
   ☐ 1-9 ☐ 50-99 ☐ 250-499 ☐ 1000-2499
   ☐ 10-49 ☐ 100-249 ☐ 500-999 ☐ More than 2500

10. **Please indicate the total sales (in 2007)**

☐ Less than 1 million US$ ☐ Between 2-10 million US$ ☐ Between 10-50 US$
☐ Between 50-80 million US$ ☐ More than 100 million US$

11. **How many employees does the company have in each of the following positions?**

Blue-collar workers	
Technicians	
Managers	
Administrative personnel	
Others (please specify)	

12. How many employees does the company have with the following educational level?

No schooling	
Elementary school	
High school (first three years)	
High school (six years)	
Technical education	
University degree	
Postgraduate studies	
Others (please specify)	

II. COLLABORATION

13 a. Please indicate in which of these projects your firm took part in the framework of the collaboration between Tanzania Gatsby Trust (TGT) and the College of Engineering and Technology (CoET) (please insert X when it applies).

Student projects	☐
Technology development and transfer workshops	☐
SME incubator program	☐
SME Stakeholders workshops (local TGTs)	☐
Feasibility study on shelter housing	☐
SMEs Gatsby Clubs	☐

13 b. What was the main added value of the collaboration for your company?

13 c. Have any other organisations been part of the collaboration? ☐ Yes ☐ No

If yes, please name which organisation: _____

III. IMPACT OF THE COLLABORATION ON THE CAPABILITIES OF YOUR FIRM

14. Have you during the last year used any of the following sources of knowledge or technology?

Please rank each source according to its importance for your firm using the following scale: 5= very important, 1= not important, NR= Not relevant.
Please also indicate whether they are domestic or foreign.
If you have not used a specific source of knowledge, leave the row blank

Source	Importance	Local or foreign	Did you start using this source as a result of the collaboration?
Suppliers of equipment and inputs		☐ Local ☐ Foreign	☐ Yes ☐ No
Public research centres		☐ Local ☐ Foreign	☐ Yes ☐ No
Universities		☐ Local ☐ Foreign	☐ Yes ☐ No
Recruitment of highly-qualified personnel		☐ Local ☐ Foreign	☐ Yes ☐ No
Licensing		☐ Local ☐ Foreign	☐ Yes ☐ No
Clients		☐ Local ☐ Foreign	☐ Yes ☐ No
Competitors		☐ Local ☐ Foreign	☐ Yes ☐ No
Consultancies of NGOs		☐ Local ☐ Foreign	☐ Yes ☐ No
Consultancies of publicly owned R&D institutes		☐ Local ☐ Foreign	☐ Yes ☐ No
Fairs, exhibitions		☐ Local ☐ Foreign	☐ Yes ☐ No
Chambers of commerce and industry associations		☐ Local ☐ Foreign	☐ Yes ☐ No
Others (please specify)		☐ Local ☐ Foreign	☐ Yes ☐ No
		☐ Local ☐ Foreign	☐ Yes ☐ No
		☐ Local ☐ Foreign	☐ Yes ☐ No

15. Please mark which of the following tasks or activities you have learned/ acquired or improved as a result of the collaboration.

A Mark only if your firm performs it (if not leave the boxes blank)	B Processes In the last three years did your firm……?	C Mark if acquired from collab.	C Mark if improved from collab.
☐	Assembly components and final goods	☐	☐
☐	Manufacture components	☐	☐
☐	Perform own-design manufacturing	☐	☐
☐	Introduce minor changes to process technology to adopt it to local conditions	☐	☐
☐	Improvement of layout	☐	☐
☐	Introduce major improvements to machinery	☐	☐
☐	Maintain the machinery and equipment.	☐	☐
☐	Introduce automation of processes	☐	☐
☐	Develop new equipment	☐	☐
☐	Introduce planning and control of production	☐	☐
☐	Select technology	☐	☐
☐	Develop new production processes	☐	☐
☐	Improve efficiency in existing work tasks	☐	☐
☐	Obtain an International certification	☐	☐
☐	Introduce radical innovations in organisation	☐	☐

A Mark only if your firm performs it (if not leave the boxes blank)	B Products	C Mark if acquired from collab.	C Mark if improved from collab.
☐	Replicate fixed specifications and designs	☐	☐
☐	Introduce new design for manufacturing	☐	☐
☐	Development of entirely new products or components	☐	☐
☐	Introduce minor adaptations to product technology (driven by market needs)	☐	☐
☐	Develop new prototypes	☐	☐
☐	R&D into new product generations	☐	☐
☐	Conduct routine quality control to maintain standards and specifications	☐	☐
☐	Improve product quality	☐	☐
☐	Conduct research into new materials and new specifications	☐	☐

16a. Did the employees acquire new knowledge through the collaboration?
☐ Yes ☐ No

b. If yes, what kind of knowledge?

c. How has it been used?

17. a. Did your firm improve its products or services?
☐ Yes ☐ No

b. If yes, how?

c. Has it had any impact on sales or exports?

18. a. Did your firm receive technical assistance for product development?
☐ Yes ☐ No

b. If yes, how has it improved your performance?

19. Did your firm acquire new machinery?
☐ Yes ☐ No

20. Did your firm obtain any certification?
☐ Yes ☐ No
If yes, please indicate which one_____

21. a. Did your firm receive technical assistance for technological processes?
☐ Yes ☐ No

b. If yes, how has it improved your performance?

22. a. Did your firm receive technical assistance to introduce organizational changes?
☐ Yes ☐ No

b. If yes, how has it improved your performance?

23. a. Through the collaboration, have you got in contact with other firms that have provided you with valuable knowledge on the following issues:

New managerial techniques	☐ Yes ☐ No
New products or services	☐ Yes ☐ No
New processes	☐ Yes ☐ No
New markets	☐ Yes ☐ No
New technological opportunities	☐ Yes ☐ No
New machinery	☐ Yes ☐ No
Other (please specify)	☐ Yes ☐ No
Other (please specify)	☐ Yes ☐ No
Other (please specify)	☐ Yes ☐ No

THANK YOU VERY MUCH FOR YOUR PARTICIPATION. WE ARE VERY GRATEFUL!

Person we should contact if there are any queries regarding the form (please fill the form or attach business card):

Name: _____
Job title: _____
Organisation: _____
Phone: _____
Fax: _____
E-mail: _____

Appendix 2 – Survey questionnaire swahili version

LUND UNIVERSITY

Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)
Lund University

Astrid Szogs

PO Box 117
22100 Lund
Sweden

Tel: +46 (0) 46 2227468
Mobile: +46 (0) 709 767667
Fax: +46 (0) 46 2224161
e-mail: astrid.szogs@circle.lu.se

Dodoso la Utafiti

Lengo la utafiti huu ni kuangalia athari za ushirikiano kati ya TGT na CoET kwenye kupokea na kupata teknolojia na maarifa, yaani (katika) kuzijengea uwezo asasi ndogondogo na zile za kati. Pia tunatathmini jinsi uwezo mpya uliopatikana unavyoweza kuathiri ubunifu.

I. HISTORIA YA KAMPUNI

1. Mwaka ilipoanzishwa	
2. Mahali/Mji	
3. Tovuti (kama ipo)	

4. **Je kampuni yako ni ya aina gani?(mf. Ujenzi, nguo, chakula, kilimo… n.k.)**
_____

5. **Tafadhari elezea shughuli za kampuni yako kwa ufupi**

6. **Umiliki**

☐ Asilimia ya mtaji wa ndani _____%
☐ Asilimia ya mtaji wa nje _____%

7. **Je kampuni yako ni mali ya familia?** ☐ Ndio ☐ Hapana

Kama ndio, je wanafamilia wangapi wanafanya kazi katika kampuni hii?_____

8. **Idadi ya waajiriwa (wastani kwa waajiriwa wa kudumu mwaka 2007)**
☐ 1-9 ☐ 50-99 ☐ 250-499 ☐ 1000-2499
☐ 10-49 ☐ 100-249 ☐ 500-999 ☐ Zaidi ya 2500

9. **Tafadhari onyesha mauzo (mwaka 2007)**

☐ Chini ya dola milioni 1 (US$) ☐ Kati ya dola milioni 2-10 (US$) ☐ Kati ya dola milioni 10-50 (US$) ☐ Kati ya dola milioni 50-80 (US$)
☐ Zaidi ya milioni 100 (US$)

11. **Je idadi ya waajiriwa katika idara/nafasi hizi ni wangapi?**

Masijala/Makarani	
Mafundi mchundo	
Mameneja	
Utawala	

Nyinginezo (elezea)	

12. Je ni waajiriwa wangapi katika kampuni wenye kiwango hiki cha elimu?

Hawajasoma	
Elimu ndogo	
Sekondari (kidato cha nne)	
Sekondari (kidato cha sita)	
Elimu ya ufundi	
Digrii/shahada	
Digrii ya pili/tatu	
Nyinginezo (elezea)	

II. USHIRIKA/USHIRIKIANO

13 a. Elezea ni miradi gani kati ya hii kampuni yako imeshirikiana na Tanzania Gastby Trust (TGT) na Chuo cha uhandisi (uinjinia) na teknolojia (College of Engineering and Technology (CoET) (weka alama ya X kwenye jibu).

Miradi ya wanafunzi	☐
Warsha za maendeleo ya teknolojia na kubadilishana maarifa	☐
Mradi wa viwanda vidogo na kati (SME)	☐
Warsha ya washikadau wa viwanda vidogo vidogo na kati (SME) (wenyeji asilia TGTs)	☐
Ukaguzi wa makazi	☐
Vilabu vya wenye viwanda vidogo vidogo na kati (SMEs) vya Gastby	☐

13 b. Je ushiriki huo umeiongozea nini katika kampuni yako?

13 c. Je kampuni yako imewahi kuwa na ushirika mwingine? ☐ Ndio ☐ Hapana
Kama ndio, taja oganizesheni/tasisi/shirika:
_____

III. MATOKEO YA USHIRIKA/USHIRIKIANO KWA KAMPUNI YAKO

14. Je mwaka uliopita umewahi kutumia vyanzo vifuatavyo vya maarifa au teknolojia?

Tafadhari onesha umuhimu wa vyanzo hivyo kwa kampuni yako kufuatana na umuhimu kwa kutumia alama zifuatazo: 5= nzuri sana, 1= si muhimu, NR= Hazihusiki.
Pia eleza kama ni vya ndani au nje ya nchi.
Kama hukutumia chanzo chochote cha maarifa tafadhari acha wazi

Chanzo	Umuhimu	Nadni au nje ya nchi	Je umeanza kutumia vyanzo hivi kama matokeo ya ushirikiano?
Wasambazaji wa vifaa na huduma		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Vituo vya utafiti wa umma		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Vyuo vikuu		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Kuajiri wataalamu kabambe		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Leseni		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Wateja		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Wapinzani/washindani		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Ushauri wa NGO		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Kufanya miradi na tasisi za utafiti and maendeleo ya umma		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Maonyesho/maon		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana

esho			
Taasisi/Vituo vya kibiashara na viwanda		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
Nyingine (elezea)		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana
		☐ Ndani ☐ Nje	☐ Ndio ☐ Hapana

15. Weka alama ya tiki kuonesha ni kazi gani umejifunza au kuboresha kutokana na ushirika.

A. Weka tiki kama kampuni yako inafanya (kama hamna acha kisanduku wazi)	**B. Uzalishaji** **Uliofanyika ndani ya miaka mitatu katika kampuni yako....?**	**C. Weka tiki Kama Umepata umeboresha ushirikani kutokana na ushirikiano**	**D. Weka tiki kama**
☐	Uunganisha vifaa na kupata bidhaa halisi	☐	☐
☐	Kutengeneza sehemu ya vifaa	☐	☐
☐	Tumia mashine binafsi	☐	☐
☐	Fanya mabadiliko madogo katika teknolojia ili kuendana na mazingira ya asilia	☐	☐
☐	Kubadili mpangilio	☐	☐
☐	Kuboresha mashine kwa kiwango kikubwa	☐	☐
☐	Kutunza mashine na vifaa	☐	☐
☐	Anzisha mashine zinazojiendesha	☐	☐
☐	Tengeneza vifaa vipya/zana mpya	☐	☐
☐	Kuanzisha upangaji na uthibiti wa	☐	☐

	uzalishaji		
☐	Chagua teknolojia	☐	☐
☐	Kuanzisha uzalishaji mpya	☐	☐
☐	Kuongeza ufanisi katika kazi za sasa	☐	☐
☐	Kupata cheti cha kimataifa	☐	☐
☐	Kufanya mabadiliko makubwa ya ubunifu katika kampuni	☐	☐

A. Weka kama kampuni yako inafanya (kama hamna acha kisanduku wazi)	**B. Bidhaa**	**C. Weka Kama Umepata ushirikani**	**D. Weka Kama umebadili toka ushirikani**
☐	Umenukuu maelezo ya kudumu na dizaini mbalimbali	☐	☐
☐	Umeanzisha namna mpya za uzalishaji/utengenezaji	☐	☐
☐	Umeanzisha dizaini mpya kabisa za bidhaa	☐	☐
☐	Umeanzisha bidhaa kwa kufanya mabadiriko madogo ya teknolojia (kutegemea masoko)	☐	☐
☐	Uendelezaji aina mpya	☐	☐
☐	Utafiti na maendeleo (R&D) katika kundi jipya la uzalishaji	☐	☐
☐	Kuchunguza mara kwa mara kuthibiti bidhaa na uchambuzi	☐	☐
☐	Kuboresha bidhaa	☐	☐
☐	Kufanya utafiti wa mali ghafi na uchambuzi	☐	☐

16a. Je waajiriwa walipata maarifa mapya kupitia ushirikiano?

☐ **Ndio** ☐ **Hapana**

b. Kama ndio, maarifa gani?

c. Hayo maarifa yalitumikaje?

17. a. Je kampuni yako iliboresha bidhaa yake au huduma zake?

☐ **Ndio** ☐ **Hapana**

b. Kama ndio, kwa namna gani?

c. Je kuna matokeo/manufaa yoyote katika mauzo au usafirishaji nje ya nchi?

18. a. Je kampuni yako imewahi pata msaada wowote wa kiufundi katika kuendeleza bidhaa?

☐ **Ndio** ☐ **Hapana**

b. Kama jibu ni ndio, je imekuongezeaje uzalishaji wako?

19. Je kampuni yako ilinunua mashine mpya?

☐ **Ndio** ☐ **Hapana**

20. Je kampuni yako ilipata cheti chochote?

☐ **Ndio** ☐ **Hapana**

Kama ndio, onesha _____

21. a. Je kampuni yako imewahi pata msaada wowote wa kiufundi katika kuendeleza teknolojia?

☐ **Ndio** ☐ **Hapana**

b. Kama jibu ni ndio, je imekuongezeaje ufanisi wako?

22. a. Je kampuni yako imewahi pata msaada wowote wa kiufundi ulipoanzisha mabadiliko ya kiutendaji?

☐ **Ndio** ☐ **Hapana**

b. Kama jibu ni ndio, je imekuongezeaje ufanisi wako?

23. a. Kupitia ushirikiano, je umepata mawasilianao na kampuni zingine ambazo zimekupa maarifa mazuri katika mambo yafuatayo:

Mbinu mpya za utawala	☐ Ndio ☐ Hapana
Bidhaa na huduma mpya	☐ Ndio ☐ Hapana
Michakato mipya	☐ Ndio ☐ Hapana
Masoko mapya	☐Ndio ☐ Hapana
Mbinu mpya za teknolojia	☐ Ndio ☐ Hapana
Mashine mpya	☐ Ndio ☐ Hapana

Other (please specify)	☐ Ndio ☐ Hapana
Nyingine (eleza)	☐ Ndio ☐ Hapana
Nyingine (eleza)	☐ Ndio ☐ Hapana

TUNASHUKURU KWA KUSHIRIKI. TUNAKUPONGEZA SANA!

Mtu wa kuwasiliana naye kama kuna maulizo kuhusu fomu hii (jaza fomu au unganisha na kadi ya kibiashara):

Jina: _____
Cheo: _____
Kampuni: _____
Simu: _____
Faksi: _____
Barua pepe: _____

Appendix 3 – Interview guide

Interview guide

Astrid Szogs
Phone office: +46 (0) 46 222 7468
Mobile pone: +46 (0) 709767667
Email: Astrid.Szogs@circle.lu.se
http://www.circle.lu.se

Company specifics, reasons for interview:

Contact details

Name and position of interviewee:
Company/organization:
Email and/ orpPhone:

Added value of collaboration- concrete illustrative examples

- Could you give any concrete examples about the main added value of the collaboration for your company?
- How exactly has it improved the design of various garments, could you describe this process in more detail?

Other participating organisations in the collaboration- intermediation

- Could you please give any specific examples of the type of involvement of other organizations in the collaboration, i.e. what has been the role of organizations you worked with (NGOs, public consultancies, universities, etc.).
- In which concrete ways have these shaped and contributed to your technological learning?
- What have been their specific tasks?
- How did you start interacting with them?
- Did you ask for specific expertise and consultancy on particular issues?
- Was any mutual benefit observed, i.e. did both parts learn from each other?

Importance of knowledge sources for firm operations and the capabilities of your firms

- Could you briefly describe your most important knowledge and/or technology sources?
- How do these sources contribute to the work of your firm?

- What has motivated/initiated your interactions with these organizations?
- Have you considered any other organizations/knowledge sources?
- Would you potentially like to collaborate with specific other actors, but are constrained by anything? (Which other organizations do you consider to collaborate with?).

- (if applicable: can you elaborate why universities or foreign knowledge are not crucial for your operations).

Tasks or activities learned or improved as a result of the collaboration

- Could you please describe some concrete examples of activities that you have learned or improved throughout the collaboration?
- On products
- On processes
- How exactly did the learning process take place?
- What type of new knowledge did your employees acquire?
    - Can you please give examples
- How has this new knowledge been used?
- Can you please give examples
- Do you have concrete examples of how and what type of products or services your firm improved?
- What is the impact on sales and export? (income generation?)
- What is the impact on the identification of the proper market and prices?
- Etc.

Acquisition of technological capabilities

- Can you please describe how exactly your firm has acquired the specific (basic, intermediate, advanced and process and product) new technological capabilities that you marked in the survey?
- Can you please specify how you have improved the technological capabilities that you have marked in the questionnaire?
- Can you please describe in detail the type of technical assistance that your firm received throughout the collaboration and in connection with the acquisition process?
- Have you received technical assistance for the development of a product, technological processes or organizational change?

New contacts with other firms

- Can you describe the most important new contacts to other firms that are the result of the collaboration?
- How was it initiated?
- In which ways is the new contact important?

- On what issues do you interact?

Challenges

Can you describe the most severe challenges that you are faced with in your daily operations?

Specific clarifications - individual to different firms

Based on the answers provided in the survey, could you please clarify the following:

- e.g. how exactly (what procedure to follow) could you obtain the certificate?
- You have marked university as knowledge source, how exactly do you access their knowledge
- Is any new certificate the result of technical assistance?
- How did you receive your certificate?

Appendix 4 – List of interviews

Mr. Mwanza, Faculty CoET, 30.03.2009

Dr. Abraham K Temu, Deputy Director, Technology Development and Transfer Center, CoET, 30.03. 2009

Dr. Elias E, Director of BICO Learning, Consultancy and Services, 30.03.2009.

Mr. Bethold Byoma, Sengerema Small Traders Association, 31.03.2009

Mr. Kelefa Mwantima, University of Dar es Salaam, 31.03.2009

Mrs. Bitrina Diyamett, COSTECH and ATPS Tanzania, 01.04.2009

Mrs. Astria Mayengera, Mayengera Investments Company, Manager, 10.07. 2009

Mrs. Grace David Ramadhani, Kampuni ya Kuponda Kokoto, Manager, 10.07. 2009

Mr. Lutembeja Lugwakala, Lugwakala Farming, Manager, 10.07.2009

Mr. Diason Damson Kalangu, P.D.Kalangu Medical Store, Manager, 10.07.2009

Mrs. Mama Mbawala, Mbawala Food Processor, Manager, 10.07.2009

Mrs. Mariam Michel Kansimba, Marium Kilimo, 20.07.2009

Mrs. Mama Eliza, Mama Elizabeth, Kampuni ya Ushonaji, Manager, 20.07.2009

Mrs. Praxeda Kahigi, Endeleza Mazingira Kome Enterprise, Manager, 21.07.2009

Mrs. Mama Anastasia, Endeleza Mazingira Kome Enterprise, seller, 21.07.2009

Mrs. Mama Sofia, Endeleza Mazingira Kome Enterprise, worker 21.07.2009

Mr. Mussa Fransisco, Pig Development Company, Manager, 21.07.2009

Mr. Robinson Mazigo, Robson Engineering Company, Manager, 21.07.2009

Mr. Salum Juma Saidi, Paulo Hotculture, Manager, 21.07.2009

Mr. Kachatiro Amos Musaka, Sawanawa Food Processors, Manager, 21.07.2009

Appendix 5 – Sample overview according to company name, year of establishment, location and industry belonging

	Company name	Year of establishment	Location city	Industry belong
1	Madutula Cotton Farm	2002	Sengerema, Mwanza	Agiculture
2	Agricultural Product Company	2001	Sengerema, Mwanza	Agiculture
3	Byoma Engineering Company	2006	Sengerema, Mwanza	Agiculture
4	Mayengera Investments Co	2000	Sengerema, Mwanza	Agiculture
5	Umoja wa Wauza Asali Kamanga	2002	Sengerema, Mwanza	Food processing
6	Sawanawa Food Processors	2005	Sengerema, Mwanza	Food processing
7	Mabula Posho Mill	2006	Sengerema, Mwanza	Food processing
8	Tupendane Group	1987	Sengerema, Mwanza	Textile
9	Tujiimalishe Group	2004	Sengerema, Mwanza	Textile
10	Shigitwa Group	2002	Sengerema, Mwanza	Agiculture
11	Saddoley Leather and Brothers	2002	Sengerema, Mwanza	Textile
12	Local Stoves Makers	2004	Sengerema, Mwanza	Cooking facilitities
13	Endeleza Mazingira Kome Enterprise	2005	Sengerema, Mwanza	Fishing
14	Cesilia Katikaza Toiloring Mart	1996	Sikonge	Textile
15	Nzega Food Processors	2002	Nzega	Food processing
16	Prisca Msekalile Tailors	2005	Sikonge	Textile

17	Kampuni ya Kuponda Kokoto	2003	Sikonge	Construction
18	Mafundi Stadi wa Nguo	2004	Sikonge	Textile
19	Kasa Tailoring Mart	2005	Sikonge	Textile
20	Masoud Spares Company Ltd	2006	Sikonge	Machines/tools making
21	Biashara ya Dagaa	2005	Sengerema, Mwanza	Food processing
22	Biengo Tailoring Mart	2001	Ilemela	Textile
23	Aisa Ally Carpentry Mart	1999	Sikonge	Construction
24	P.D.Kalangu Medical Store	2003	Sikonge	Health services
25	Jikwamuwe Uishi	2000	Ilemela	Textile
26	Pig Development Company	2005	Sengerema, Mwanza	Agiculture
27	Mama na Mwana Garments Manufacturing Company	2005	Sengerema, Mwanza	Textile
28	Marium Kilimo Bora Development Company	2001	Sikonge	Agiculture
29	Mbawala Food Processor	2003	Nyamagana	Food processing
30	Mama Elizabeth Kampuni ya Ushonaji	2003	Ilemela	Textile
31	Magesa Salon Enterprise	2006	Ilemela	Saloon
32	Grace Food Processing Company	2002	Nyamagana	Food processing
33	Kampuni ya Ushonaji	2001	Ilemela	Textile
34	Nkomba Secretarial Services	2006	Sengerema, Mwanza	Education facilities/services
35	Yasini Makoba Bricks Makers	2003	Nzega	Construction

36	Mayday Bakery Company	2005	Sengerema, Mwanza	Cooking facilitities
37	Ushonaji	2003	Sengerema, Mwanza	Textile
38	Kampuni ya Ufumaji	2002	Sengerema, Mwanza	Textile
39	Ufumaji Tailoring Mart	2003	Sengerema, Mwanza	Textile
40	Maendeleo Ushonaji	1985	Nyamagana	Textile
41	Robson Engineering Company	2000	Sengerema, Mwanza	Construction
42	Lugwakala Farming	2005	Sengerema, Mwanza	Agiculture
43	Salum Juma Salum Agriculture Company	2002	Sikonge	Agiculture
44	Abdalah Mohamed Tailoring Mart	2004	Sikonge	Textile
45	Sikonge Batik Products	2005	Sikonge	Textile
46	Maziku Poutry Livestock Company	2001	Nzega	Agiculture
47	Asha Agriculture Company	1995	Nzega	Agiculture
48	Mama na Mwana Tailoring	2004	Sengerema, Mwanza	Textile
49	Kasokola Sofas	2002	Sengerema, Mwanza	Carpentry
50	Nyamiswi Women Group	2003	Sengerema, Mwanza	Food processing
51	Juhudi na Maendeleo	2006	Sikonge	Agiculture
52	Paulo Hotculture	2005	Sikonge	Agiculture
53	Said Hotculture	2004	Sikonge	Agiculture
54	Kasimu Marki Kangelo	2006	Sikonge	Machines/tools making
55	Neri Garments	1999	Sikonge	Textile

56	Kimwaga Transport and Livestock Investment	2003	Sikonge	Agiculture
57	Juhudi Malengo	2006	Nyakasungwa	Agiculture
58	Ngufuli Processor Company	2002	Sengerema, Mwanza	Food processing
59	Sikonge Wasindikaji	2004	Sikonge	Food processing
60	Juhudi na Malengo	2006	Nyakasungwa	Agiculture
61	Kalama Grocery	2002	Sikonge	Food processing
62	Juhudi na Malengo	2006	Nyakasungwa	Food processing
63	Muwakwami Enterprise	2006	Sengerema, Mwanza	Carpentry
64	Chande Carpentry	2004	Nzega	Carpentry
65	Violet Tailoring Mart	2003	Nzega	Textile
66	Michael Bakery and Brick Moulding Company	2003	Sikonge	Construction
67	Budeba Company Ltd	2002	Sengerema, Mwanza	Machines/tools making
68	Ngoye Poultry Company Ltd	2004	Nzega	Agiculture
69	Rhoda Processing Company Ltd	2004	Sikonge	Agiculture
70	Deogratias Grocery	2001	Nzega	Food processing
71	Said Shabani Agriculture Products	2002	Sengerema, Mwanza	Agiculture
72	Mshina Group	2005	Sengerema, Mwanza	Agiculture
73	Juhudi na Malengo	2006	Nyakasungwa	Agiculture
74	Ujamaa Garment Company Ltd	1996	Sikonge	Textile

75	Gorofani	2000	Kasulu-Kigoma	Food processing
76	Juma Shegembi Fishing	2006	Sengerema, Mwanza	Fishing
77	Kasusu Bakery Company	2003	Sengerema, Mwanza	Food processing
78	Kisima cha Chumvi Farming	2004	Sengerema, Mwanza	Agiculture
79	Mbogo Environmental Protection Company	2001	Sengerema, Mwanza	Cooking facilitities
80	Caren Mtindi Fishing Company	2005	Sengerema, Mwanza	Fishing
81	Asha Tega Carving Enterprise	2006	Sengerema, Mwanza	Carving
82	Kampuni ya Ususi	2003	Sengerema, Mwanza	Weaving
83	Kampuni ya Kuchakata Samaki Kome Sengera	1997	Sengerema, Mwanza	Fishing
84	Iyogelo Cassava Farming	2004	Sengerema, Mwanza	Agiculture
85	Local Stoves Manufacturing Company	2003	Sengerema, Mwanza	Cooking facilitities
86	Jeremia Kapaya	2003	Sengerema, Mwanza	Agiculture
87	Nkarango Cotton Grower Company	2000	Sengerema, Mwanza	Agiculture
88	Obotto Fish Products Company	2003	Sengerema, Mwanza	Fishing
Total	88	88	88	88