PROBLEMS AND CONSTRAINTS OF INNOVATION LINKAGES BETWEEN R&Ds –SMEs IN DEVELOPING COUNTRIES: The case of Tanzania metal work enterprises

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Theories of various innovation models show that innovation development and application in Small and Medium Enterprises (SMEs) are costly and risky, making firms particularly in developing countries, to either stagnate, reverse or fail to grow. It is from these facts that a study on "Modeling Effects of Determinants of Innovation Linkages between R&Ds- SMEs in Developing Countries" was undertaken to establish the nature, extent and effects of the determinants of innovation linkages. The paper, focuses only on the problems and constraints of innovation linkages. The discussion of the findings is based on the preliminary data collected from a questionnaire which was administered to SMEs s in ten regions of Tanzania. Preliminary analysis indicate that innovation linkages depend on SME size and are limited/constrained by various factors.

1. INTRODUCTION

Globalization and liberalization has characterized the world by continuous innovation under the pressure of competitiveness, productivity and demand. For the country to stay "alive" and remain competitive, it must innovate. Innovation is therefore portrayed as the backbone of any industry, be it high-tech or low-tech, large scale enterprises, small and medium enterprises (SMEs). There is now an emerging consensus that the performance of SMEs in general is linked with the ability to innovate. SMEs particularly in developing countries are one of the channels through which a country can be competitive. Their role is critical in eradicating poverty.

In Tanzania, in particular, the importance of SMEs and innovation is in their role and contributions to technology development and their employment creating potentials. SMEs are a vehicle for creating income in both rural and urban areas. In recognition of the above fact, Tanzania in 2002 proclaimed SME Policy that could stimulate development of SMEs. One of the SME policy priorities is to facilitate the acquisition and adaptation of technologies as well as to enhance linkages between R&D institutions and SMEs in a bid to upgrade technology so as to raise the productivity and competitiveness of the sector.

The paper focuses on the innovation linkages and their problems and constraints. The discussion of the findings is based on the data collected from a questionnaire which was administered to SMEs in ten regions of Tanzania.

2. OBJECTIVES

Overall objective

The overall objective of the study is to model the effects of determinants of innovation linkages between R&Ds - SMEs.

Specific objectives

i. Identify the determinants of innovation linkages between R&Ds – SMEs;
ii. Establish the effects of determinants of innovation linkages between R&Ds - SMEs ; and
iii. Model the effects of determinants of innovation linkages between R&Ds – SMEs.

3. CONCEPTUAL CLARIFICATIONS

Various types of linkages have been identified in the literature. Johansson (1987) defines linkage as the flow of information and/or materials between two or more individuals. Bången (1998) defines linkage as a relationship between economic actors which accrues as a result of information and/or material exchange. Bången, 1998 further identifies two types of linkages: market exchange linkage and relational exchange linkages. The relational exchange linkage involve interaction in activities, resources as well as actors in the process of producing goods and services, while market exchange involve interaction in buying and selling of products and services.. Hemmer (1989) identifies two types of linkages, the distributive and sub-contracting linkages. He further describes distributive and subcontracting linkages as occurs when certain lines of production prove unprofitable for one SME as a way to lower overhead costs. Other types of linkages as identified by various studies include, direct and indirect linkages, productive linkages, consumptive linkages, credit financing linkages and technological linkages. All these types of linkages display a considerable degree of overlap hence they can be brought under the ambit of backward and forward linkages without any loss of meaning (Arimah, 2001). The definition of innovation linkage in this study therefore means the linkage between two or more firms which makes them either adopt/adapt innovation (idea/information) or contribute towards accomplishing the innovation process or product.

3. METHODOLOGY

The survey was carried out in ten (10) regions of Tanzania, namely, Dar es salaam, Morogoro, Tanga, Kilimanjaro, Arusha, Dodoma, Shinyanga, Mwanza, Iringa and Mbeya. The survey was designed to obtain information on the various characteristics of determinants of R&D-SME innovation linkages and whether those linkages contribute to firm's growth. Survey information was collected using a questionnaire, interview and case study. The survey covered 112 SMEs, 7 R&Ds and 2 universities with metal work related activities. It was observed that 104 SMEs out of 112 sampled SMEs responded to the questionnaire. This shows the questionnaire return rate of 93%.

4. PRESENTATION AND DISCUSSION OF THE PRELIMINARY FINDINGS

4.2 PRODUCTION INPUTS OF SMEs

4.2.1 Raw Materials

The study revealed that the bulky of raw materials used by SMEs are from Mild steel (98%) followed by Copper (18%) and Aluminium (15%). The robustness and quality of the design products depend on the available raw materials in use. This not only limits SMEs to grow but also to compete with each other. For instance, Mild steel which is commonly used is unsuitable for high stress and long life shafting, gears, bearing, machine parts and equipment of industrial and agricultural use. The spectrum of raw materials suggests that these SMEs can in no way produce advanced machines and machineries. The type and quality of input is an indicator for quality of output.

A comparative analysis by SME size shows that, Mild steel is consumed most by small enterprises followed by micro enterprises and medium enterprises. Alminium and Copper are commonly used at a small scale by medium, small and micro predominantly for motor vehicle, domestic appliances while Cast iron consumption was observed to be used at a small scale by medium enterprise and not used by small and micro enterprises.

Majority of SMEs that use scrap materials are small enterprises (29%) followed by micro enterprises (19%) and medium enterprises (2%). On the other hand raw materials are mainly used

by medium enterprises (24%) followed by small enterprises (17%) and a few micro enterprises (7%).

The observations suggest that micro and small enterprises are observed to use both scrap materials as well as raw materials, while only 2% of the medium enterprises uses scrap metals. This shows that availability of materials is one of the hindrances to product development in micro and small enterprises.

4.2.2 Production Machines

The bulky of production machines is of metal joining type (82.6%), followed by cutting machines (76.92%) and the metal forming machines 59.62%. On the other hand finishing and casting machines exist at very low level at 6% and 5.8% respectively. The availability of metal joining, cutting and forming machines provide a good basis for SMEs to venture into manufacturing of heavy machines. However, the lack of supporting basic iron industry/casting machines remains a major hindrance. Lack of finishing machines makes manufacturer to skip finishing operations that are indeed very important in the course of producing high quality products.

Finishing machines were observed in small and medium only this shows that the quality of product improves as you move from small to medium enterprises. Casting operations were only observed in micro and medium and none in small enterprises. Casting operations in micro was basically used in blacksmith activities such as castings for domestic appliances and agricultural implement part(s). A comparative analysis by firm size shows that the use of cutting, forming and joining machines is high in small followed by medium and micro enterprises. Casting activities were observed at small scale most probably due to the fact that smelting crucibles are quite expensive.

4.2.3 Technical Manpower

The total number of employees of metal engineering SMEs vary from 4 – 24 employees, with engineers ranging from 0- 3, technicians from 0-11 and artisans 2-24. An analysis of the data on the composition of the technical employees revealed 79% of SMEs did not have engineers at all about 43% had neither engineers nor technicians. The overall ratio of engineers-technicians-artisans was found to be 1:3:17 (basing ob the sum ratio of 28:76:46) or 0:1:7 (basing on the mean ratio of 0.3: 0.8:4). This analysis does not take into consideration the type of qualification of the technical cadre. If compared to the ILO standard ratio of 1:5:25 it can be concluded that the metal engineering SMEs have trained less technicians and artisans than it needs. For the metal engineering SMEs to develop they must have the right technical personnel in terms of the number of qualifications in the right field and at the right ratio. An engineering biased metal industry would be less effective in designing and manufacturing of quality products.

The observation revealed that the availability of engineers and technicians are dependent of SME size (χ^2 = 39.115, d.f. =2) for engineers while for technicians (χ^2 = 19.445, d.f. =2)). Artisans were not dependent of SME size. It was further observed that medium enterprises have more engineers (17%) followed by small (5%) and micro enterprises (1%). The number of technicians are highest in small enterprises (25%) followed by medium (22%) and micro enterprises (7%) while the number of artisans are highest in small 48(%) followed by micro (28 %) and medium enterprises (24%) .

4.3 PRODUCTION OUTPUTS OF SMEs

4.3.1 SME products

Major SME products are agricultural equipment (30%) such as ploughs, ridgers, planters, post harvest machinery etc., construction equipment and machinery (brick machines, steels, nails, hinges, and locks-31%), domestic appliances (utensils, spoons, knives, and bucket-7%), motor vehicle parts (4%) and simple machine spare parts (17%). The study disclosed further that most SMEs have embarked on the manufacturing of machines. However, most of these products are simple and un-powered.

A comparative analysis of SMEs products shows that small enterprises are leading in the production of agricultural implements, construction equipments, motor vehicle and spare parts followed by micro and medium enterprise respectively. Motor vehicle parts are predominantly produced by small enterprises and domestic appliances are produced by medium followed by micro enterprises and non- existent in small enterprises.

4.4 INNOVATION AND TECHNOLOGY CHANGES IN SMEs

Over the last three years 12% of SMEs have afforded to change their technologies through purchase of new machines. The main reasons for un-affordability of purchasing new machines for SMEs are the low annual income and lack of credit facilities. However, 31% of SMEs have been innovative in modifying/improving their production machines to suit their purposes.

A comparative analysis shows that 11% of medium enterprises have afforded purchasing new machines while almost none of small and micro afforded to buy one. On the one hand although small enterprises and micro enterprises can not afford buying new machines, they predominantly improve their products (small enterprise 37%, micro enterprise 25% of medium enterprises 15%). This could be due to their in-house improvement of their existing production machines.

4.5 INNOVATION LINKAGES OF SMEs

4.5.1 Backward Linkages

The backward linkages that are examined pertain to utilization of raw materials, requirements of prototype development/product improvement, technical manpower and adoption of new technology.

Raw materials linkage

The facilitation of raw materials by government, NGOs, large companies and SIDO account for 5%, 9%, 18%, 23% respectively. This shows that most SMEs have more backward linkages with SIDO followed by large companies. SIDO has been active in facilitation of scrap metals from large companies/government departments to SMEs.

A comparative analysis shows that only medium enterprises have backward linkages with government, followed by small enterprises. Medium enterprises have more backward linkages with large companies, SIDO and NGOs followed by small and micro enterprises. This shows that backward linkages depend on size of SME.

Technical manpower linkage

Most SMEs were observed to have backward linkages by employing technical manpower from VETA (96%), technical colleges (41%) and universities (18%). Only 1% responded to have technical manpower from R&Ds. The high percentage of employees form VETA is due to the high number of artisans in most SMES who undertook their training in VETA centres. The 41% and 18% represents the technicians and engineers found in SMEs.

A comparative analysis shows that VETA has contributed the highest number of technical manpower to all categories of SMEs (small 56%, medium, 26%, and micro, 26%), while technical colleges have the highest contribution to medium (21%) followed by small (13%) and micro (5%). University have highest contribution to medium SMEs (13%) followed by small (4%) and micro (1%). This shows that there are more chances of having technicians and engineers in either small or medium enterprises.

Product improvement linkage
With regard to improvement of products, most SMEs have backward linkages with SIDO (38%), NGOs (20%), R&Ds (13%) and universities (6%). Only 1 % responded to have a government linkage on the improvement of product.

A comparative analysis shows that only medium enterprises have backward linkages with government. Backward linkages with SIDO on all SMEs categories are highest. Small and micro enterprises ranked highest in linking with SIDO followed by medium enterprises. Medium enterprises have more linkages with R&Ds followed by small and micro enterprises. Mediums have high linkages with NGOs followed by small and micro enterprises. The observations further revealed that universities have linkages with medium and almost none with small and micro enterprises.

Technology information
With regard to technology information, most SMEs have backward linkages with SIDO (47%), R&Ds (32%), NGOs (19%) and university (14%). Only 4% responded to have backward linkages with the government.

The observation revealed that the availability of technology information which were dependent on SME size were trade fair ($\chi^2 = 7.316$, d.f. =2), internet ($\chi^2 = 10.18$, d.f. =2), projects ($\chi^2 = 20.4$, d.f. =2) and technical manpower ($\chi^2 = 38.844$, d.f. =2), while exhibitions ($\chi^2 = 3.853$, d.f. =2), training ($\chi^2 = 5.031$, d.f. =2) were not dependent of SME size. It was further revealed that major sources of technology information was exhibitions (52%), followed by training (48%), trade fair (41%), projects (23%), technical manpower (14%) and internet (11%).

A comparative analysis shows that only medium enterprises have linkages with government. The observation further revealed that small enterprises have more linkages with R&Ds followed by medium and micro enterprises. The observation also revealed that small enterprises have more linkages with SIDO followed by micro and medium while for both NGOs and universities small enterprises have more linkages followed by medium and micro enterprises. Medium and small enterprises are more linked with NGOs and universities while with micro enterprises the linkages are negligible.

Collaborative prototype development linkage
Collaborative-prototype –development linkage involves SMEs being involved in one way or the other in developing a certain prototype. This was observed in some NGOs projects/programs and SIDO-TDCs as well as universities. The observation revealed that SMES have collaborative-prototype –development linkage with SIDO (12%), NGO (12%), and universities (6%). A comparative analysis shows that small enterprises have the highest linkages with SIDO followed by micro and medium. Small and medium only have equal response on linkages with NGOs while only medium and micro have linkages with R&Ds/universities.

Product perfection linkage

A perfection of product involves SMEs to develop a prototype and final products to projects (NGOs/R&Ds/Universities) The comments from the project targeted community are communicated back to SMEs for further improvement. Perfection of products is highest with NGOs (18%) followed by SIDO (17%) and R&Ds (8%).

A comparative analysis shows that the product improvement linkages with SIDO is highest in small followed by micro and relatively low in medium enterprises. The observation revealed that product improvement linkage with NGO was highest in medium followed by small and micro enterprises. Perfection of product linkages with both R&Ds and universities in medium enterprises were highest while in small and micro was almost negligible.

4.5.2 Forward linkages

Responses on the forward linkages were quite low. The two types of forward linkage considered pertain to sub-contracting agreement and the flow of technical manpower from small to medium or from small and/or medium enterprises to large scale enterprises. Reasons for the low level of forward linkages include the low capacity of production of SMEs and lack of government support.

Technical manpower linkage

The technical manpower linkage involves the movement of technical manpower from SMEs to large enterprises. It was observed the mobility of technical manpower was dependent on SME size (x^2 = 38.844, d.f =2, 5%). It was further observed that medium enterprises had high percentage of mobility of manpower from other SMEs (13%) followed by small enterprises (1%) while in the micro enterprises such linkages were non –existent.

Sub-contracting agreements linkage

It was observed that sub contracting agreement linkage was of SME- SME type. The sub-contracting linkage involve one SMEs lacking appropriate production machine/expertise and sub-contracts other enterprise to either accomplish a certain product activity. This is more effective if the sub-contracted SME is in the proximity.

The observation revealed that sub contract agreements are dependent on the SME size (x^2 = 13.486, d.f =2, 5%). The study further observed that sub contract agreements was high in small enterprises (14%) followed by micro enterprises (11%) and medium (2%). The high percent of sub-contract agreement in small and micro is because of lack of some production machinery for other innovation activities which makes them subcontract to other SMEs. The small percent of medium enterprises is because of relatively adequate production machinery for most of their activities hence they do most of the contracted activities by themselves.

5.0 CONCLUDING REMARKS

This study has sought to identify and account for the nature of SMEs innovation linkages in Tanzania. The SMEs were seen to have both backward and forward linkages. The backward linkages include the flow of raw materials, equipment, finance and consumer goods from SMEs to R&Ds. The major sources of backward linkages were government agencies, large domestic companies and foreign-based companies.

The forward linkages entail the flow of goods and services from SMEs as inputs into the latter. Two major types of forward linkages were identified. These are subcontracting agreements with SMEs, government agencies on the one hand, and the flow of technical manpower from SME to large scale enterprises.

Preliminary findings indicate that, characteristics of innovation linkages vary from one innovation activity to another. It also depends on the size of SMEs. Though innovation linkages were featured as one of the multifaceted efforts by SMEs which were cost and time effective, the linkages were observed to be limited or constrained by a number of factors/determinants such as: level of investment, annual income, technology information, knowledge and skills, training and organizational factor. Subsequent analysis will alienate sensitivity of such determinants of innovation linkages.

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