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Full Length Research Paper

The logarithmic relationship between collective efficiency and technology development in wood enterprises in Kenya

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Small Manufacturing Enterprises (SMEs) contribute to economic dynamism, entrepreneurship and have potentials to contribute to sustainable industrial development in less developed countries (LDCs). They are however handicapped since they lack the capacity to develop infrastructure and acquire technologies that give them a competitive advantage in the global market. This paper explores collective efficiency as a paradigm that could inform technology development in LDCs to enhance SMEs growth. Data was obtained from wood based enterprises owner/managers (284) who were sampled from three districts Kericho, Nakuru and Uasin Gishu all in the Rift valley province of Kenya using multistage sampling strategy. Data was collected by use of questionnaires, observation and documentary analysis. Using regression analysis the study found the relationship between collective efficiency and technology development in wood based enterprises to be logarithmic. This revealed that the rate of change in technology development is higher with higher levels of joint actions up to a certain maximum point when further joint actions do not benefit the wood based enterprise. These findings demonstrate the need for a paradigm shift in the support of SMEs sector in order to sustain industrial development. The use of collective efficiency paradigm in the planning and development of infrastructure that anchors technology development for the SMEs is recommended.

Key words: Wood based enterprises, collective efficiency, technology development, small manufacturing enterprises.

INTRODUCTION

Small Manufacturing Enterprises (SMEs) (SMEs are used here to mean all enterprises engaged with the manufacture/production of artefacts for sale as a business venture employing less than 50 employees) have been noted to play a significant role in promoting economic growth in less developed countries (LDCs), developing and developed countries (Liedholm and Mead, 1999). Small enterprises contribute to economic dynamism and entrepreneurship and it is argued in this paper that for sustainable industrial development in LDCs, the SMEs will have to play a pivotal role. As united nations industrial development organization (UNIDO, 1998) puts it, sustainable industrial development is a process of developing land, cities, businesses and communities to meet the needs of the people or nation, without compromising on the ability of future generations to meet their own needs. Consequently, in LDCs sustainable development has to target rural development with strategies that support the rural poor extending benefits of development to them.

Since the 1980s, African economies have endeavoured to give micro interventions that have sought to create and promote the development of enterprises or ease their

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constraints through direct assistance in the field of finance, technology and skills upgrading. Yet, the envisaged growth and transition, graduation of SMEs from micro to small, small to medium and medium to large enterprises does not seem to be taking place (Lukac's, 2005). For SMEs to be drivers of industrialization, then such transition becomes a necessity for SMEs in LDCs. Further, the SMEs must be self sustaining through technological innovations and building competitive advantages in a liberalized global market. Most SMEs are not able to do this on their own. SMEs in developing countries remain in traditional activities generally with low levels of productivity, poor quality products and serving small localized markets. Lukacs (2005) asserts that there is little or no technological dynamism in this group, and few 'graduate' into large size or modern technologies. In many poor countries, there is also a large underclass of (formal and informal) micro enterprises that ekes out a bare survival. Researchers have argued for and against intervention or support for the sector under sector growth, job creation, and use of local resources, social and political impacts. There is need therefore to investigate the extent to which collective efficiency is employed in planning and developing infrastructure that supports technology development in SMEs that in turn facilities the growth of SMEs.

Research on the growth of small manufacturing firms in less developed countries reveals two types of small producers; those geographically dispersed producers, mainly rural based small firms, whose growth prospects depend on demand from local agricultural activities and those that form clusters of small and micro enterprises (Nadvi, 1999). Clustering is used here to mean geographical and sectoral concentration of enterprises (Schmitz, 1995). Infrastructure and technology are a challenge for SMEs in LDCs who are hard put to accumulate capital hence can do little on their own to support infrastructure and technology development. This calls for the adoption of the collective efficiency paradigm in the planning and development of infrastructure in LDCs. Infrastructure offers supportive structure for the growth of other sectors, raises growth of enterprises and reduces income inequity (Lopez, 2004). Infrastructure planning and development, especially in rural areas should support technology adoption and innovation that in turn leads to enterprises growth and building of competitive advantage. This does not seem to happen in LDCs where SMEs remain generations behind in the kind of technology they employ. This is one area where policy pronouncements has not fully succeeded in creating a direct connection between infrastructure development, technology acquisition, adoption and development and thus the growth of individual SMEs.

Research seems also to be treating this as separate and more so, not emphatically establishing empirically the significance of the differences between the inter-relationship from one region to the other, one country to the other and one society to the next. In this subsector study, the wood industry is used to examine the extent to which collective efficiency paradigm (collective efficiency refers to joint actions or collective efforts that are made by enterprises working together to facilitate their individual enterprises improved performance) is used in supporting the acquisition, adoption, transfer and development of technology that in turn support the growth of the wood enterprises and by extension SMEs. The use of the wood industry is appropriate since forests are important renewable assets of a country's wealth. Forests provide renewable raw materials for a wide range of industries with wood industries providing a wide range of products for consumption and intermediate purposes thereby contributing to economic growth and development of a region or country.

Problem statement

In Kenya, the performance of the wood industry has continued to decline over the years. As at 2009, virtually all large sawmills had collapsed leading to the closure of Pan Africa Paper Mills that was producing 80% of the pulp and paper products in Kenya. Between 2001 and 2002, the wood and cork subsector performance dropped by 56% while import of timber increased from 78.2 to 606 m^3 in the same period (Kenya, 2003). While the poor performance in the wood industry has been attributed to the ban of logging which in itself is a manifestation of poor infrastructure planning, it is also indicative of the challenges faced in the growth of small manufacturing enterprises within this sector. There is however, insufficient literature on the use of networking and collective efficiency as a paradigm that informs infrastructure and technology development that in turn support the growth of SMEs in LDCs.

This paper examines the extent to which collective efficiency is employed in the wood industry subsector in Western Kenya and the extent to which it influences technology development in wood based enterprises.

Conceptual framework for the study

Since SMEs in LDCs are unable to develop infrastructure and technology significantly on their own, then collective efficiency paradigm need inform the infrastructure planning and development so that SMEs engage in joint actions. Collective efficiency here, refers to joint actions or collective efforts that are made by enterprises working together to facilitate their individual enterprises improved performance. The thesis here is that this joint actions needs to be engineered in the planning and developing of industrial infrastructure, targeting to support SMEs access better or improved technology and hence the growth of the individual enterprises and the sector as whole and its contribution to the industrialization process. The joint actions, as noted by Nadvi et al. (1994) works better when small manufacturing enterprises work/operate close together in clusters.

Nadvi et al. (1994) and Schimitz (1995) notes that industrial clusters are concerned with local growth processes that arise from sectoral and regional concentration of small and medium sized firms that facilitates gain in efficiency and flexibility. As pointed out by Schimitz (1995), the concept of collective efficiency is facilitated by the clustering on a number of subsequent development factors which include labour division; specialization by SMEs; rapid production of specialized products; emergency of suppliers to handle raw materials, component parts and machinery; emergency of service providers such as technical, legal, communication among others; emergency of marketing agents; emergency of a pool of skilled workers and formation of consortia or associations for specific services and lobbying all of which need to be considered in infrastructure planning and development.

In infrastructure planning, Ombura (1997) points that infrastructure networks are useful instruments within network economies. Infrastructure and related services help to make things happen, it feeds and it is fed by trade, it fuels foreign direct investment, it backs up the creation and sustainability of industrial clusters, it cuts costs and raises competitiveness. Infrastructure includes both hard and soft: Ports Airports, Railway systems, Road Networks Power, communication, water, waste management, IT, Legal, Financial and Technological infrastructure (Ishikawa, 2002).

Infrastructure planning begins with industrial location choices which place spatial distribution of industry in reference to other social aspects. A spatial planning approach ensures the most efficient use of land by balancing competing demands within the context of sustainable development (Rozee, 3003). It becomes an ongoing, enduring process of managing change by a range of actors, in the interests of sustainable development (Tewdwr, 2004). This makes efforts to promote industrial development extremely urgent and rural focused. A sustainable industrial policy and development strategies encompassing a variety of inter-related economic, social and environment objectives such as encouragement of an open and competitive economy, the creation of productive employment and protection of the natural resources through efficient use of renewable and non renewable resources required. Such a policy and strategy should create a self sustaining industrial sector having strong linkages with domestic economy.

This, network analysis approach in infrastructure planning portends that co-operative mechanism should be established alongside the competitive rules of behaviour and take advantage of collective differentiation and learning (Ombura, 1997).

It emphasizes pooling together to create infrastructure for use in network economies. This leads to the combined improvement in the fields of technology, marketing, transportation, communication, access to services and waste management with the benefit of reduced costs in overcoming difference. This should work together or in conjunction with the systems theory which requires that facility configuration be done in a distinctive but interrelated and inter dependent pattern (Catamase and Synder, 1988). Small manufacturing enterprises represent such systems where interactions between infrastructure and technology determine enterprise development trends in a collective and networking environment. This brings to the fore the need for industrial infrastructure planning and development that seeks to promote access to acquisition and development of technologies that lead to improved efficiency, effectiveness and productivity of the small manufacturing enterprises. Thus, SMEs cannot attain growth unless they employ technologies that allow for competitiveness.

The technology acquisition and development can only be facilitated by appropriate and relevant infrastructure to be determined in a networking and collective approach. In technology development, Gushesh (2003) indicates that technology is accepted by society depending on the social context, the perceived ease of use and perceived usefulness in addressing society's immediate needs. This means that society should be involved in determining what technology it needs and the direction along which it should be developed (Constructivism). Traditionally, theories of technology have been informed by the determinist ideology which holds that the path for development is dictated by technical necessities and that pursuit for efficiency controls the direction of this path without any reference to society (Feenberg, 1999). Critics to this ideology have argued that when choices are presented in the path of technological development, social influences play a vital role. Constructivism puts forth an alternative ideology of technology development.

According to Gushesh (2003) technical design is influenced by society since human needs are seen to have cultural base. Thus cultures and societies would have different definitions of technology that would be appropriate to the context of that society. That would

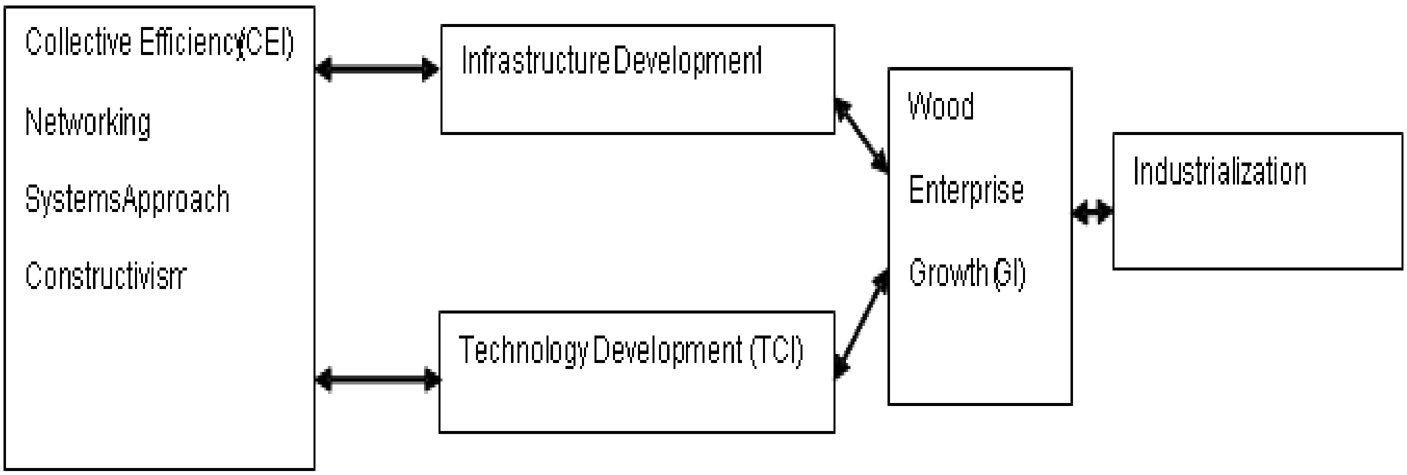

Figure 1. Collective efficiency as a basis for infrastructure, technology and SME growth.

explain why modern technologies that have succeeded in developed countries fail in less developed countries and hence the need to engage local communities in participatory approaches when developing technologies appropriate to their context. This study is informed by collective efficiency theory in SMEs growth, networking and systems approach in infrastructure planning and development and constructivism in technology development as seen in Figure 1. The relationship between collective efficiency and technology development is tested using the production function that relates outputs to its underlying factor inputs. A production function is a purely technical relationship, void of economic content (Harry, 1998). It is simply a set of recipes or techniques for combining inputs to produce output. Only efficient techniques qualify for inclusion in the function however, namely those yielding maximum output from any given combination of inputs (Humprey, 1997).

Inputs into an industrial sector, infrastructure and technology leads to growth output in the wood industries sector.

The hypothesis tested for linear, exponential and logarithmic relationships is collective efficiency (CEI) does not play a significant role in influencing the technology development (measured in terms of technological complexity index (TCI)) in wood based enterprises in western Kenya. $H0_4$: TCI = f(CEI).

The collective efficiency index (CEI) variable was synthesized from the respondent's involvement in collective efforts sub variables which included backward and forward linkage; subcontracting; sharing of equipment; networking and information sharing; sector quality standards; sector association; and partnerships. The measure of technological development (TCI) in the wood enterprises was synthesized from the sub variables skills covering education; training and staff development as well as experience and exposure; production process and methods used in the transformation process covering type of technology and how the technology was acquired and the methods used to ensure quality products and quality assurance and finally the market niche served.

REASARCH METHEODOLOGY

The study was an expost facto subsectoral survey in three categories of wood enterprises, sawmill; panel production enterprises and furniture making enterprises in three districts, Uasin Gishu; Kericho and Nakuru all in the Rift Valley province of Kenya.

The three study sites have the largest proportion of wood industries in Kenya and have climatic conditions favourable for both indigenous and exotic forest covers. The districts also have fairly well developed social economic infrastructure with agriculture being the predominant source of income for the majority of the residents. The target population was owner/managers of wood enterprises in the three districts. The number of sawmills were 135, 341 furniture making enterprises and three (3) panel products. For sampling purposes the administrative divisions in the three districts were used as sampling unit and the main shopping centres in each division sampled for data collection. The sample size was determined to be 284 (3 panel production enterprises, 100 saw mills and 181 furniture producing enterprises) using the Krejcie et al. (1970) model.

A multistage sampling strategy was adopted for the study. The three districts all from Rift Valley were selected purposively because Rift Valley has 47% of all forested area in Kenya with the three districts having 61.1% of the sawmills in rift valley (Kenya, 1999). The districts were then sub divided according to their administrative division to form sampling clusters which were then selected for the study by random sampling, with the sampled wood enterprises distributed proportionately (sampling list of major wood industries was obtained from the forestry department in each district). For the small furniture manufacturing enterprises whose elaborate sampling frame could not be obtained either because they are licensed a “workshops” alongside other enterprise such a metal or automotive workshops or they are not licensed, snowballing approach was used again and again until the desired sample size for the division in each sampled shopping centre was achieved. Data was collected by use of a questionnaire containing both open and closed ended questions, an observation checklist and a secondary data survey guide.

Error variance minimisation was considered at the research design stage and sampling employing the principle of triangulation where exclusive use of one method would bias or distort the picture of the particular slice of reality under investigation (Cohen et al., 2000). The content validity of data collection instruments were ascertained by peer examination of the instruments against stated study objectives and also by pre-testing the instrument. Consistency and replicability of the research instrument over time was established by the use of the test-retest method where ten (10) respondents were selected from the neighbouring Tranzoia district and the instrument administered twice with a two months intervening period.

The test score were correlated against the retest scores and a Karl Pearson’s product moment coefficient of correlation(r) of 0.931 obtained and a coefficient of determination (R^2) = 0.866 indicating strong instruments reliability. It should be noted however, that reliability cannot be assessed on a purely statistical basis and measures obtained in such studies are not the ultimate explanatory factors but merely indicators of the presence of factors that cumulatively add up to and are interpreted to construct the explanatory factors in form of variable that are used in the analysis models (Cohen et al., 2000).

Dependability of data in this study has therefore been achieved by respondents checks, debriefing by other scholars and peers, triangulation, prolonged engagement in the field, repeat visits, persistent observation and studying industry records and data so that the study findings are consistent with the reality of the wood industry on the ground.

In data analysis, codes were also used as scores. Care was taken to put into consideration the factors of theory (what is known about possible responses), mutual exclusivity and exhaustiveness and details that should be factored into the coding decisions. Some variables were measured and coded by aggregation of measures for various sub-variables and also aggregating scores for responses that are not mutually exclusive. Numeric data took the value of the numeral used as the code for the response but care was taken to ensure that they were in the same units. Descriptive data analysis was used for both qualitative and quantitative data.
Correlation analysis and chi square tests were used to indicate the direction along which analysis should proceed. Paired T test and ANOVA were carried out to check the variations between wood industry categories and between study districts. Regression was carried out after scatter plots suggested linear relationships exists to establish the strength of the relationship by determining the Karl Pearson’s product moment coefficient of correlation (r) and the coefficient of determination (R^2) to explain the extent of the influence of the collective efficiency index (CEI) on the change in the technology development index (TCI). A regression model was obtained for the linear, exponential and logarithmic relationships and curve fitting estimation carried out since both exponential and logarithmic relationships were seen to be significantly stronger than the linear relationship. Finally, the α constant and β coefficient were tested for significance by the use of the true input estimate of parameters.

STUDY FINDINGS

The study findings are presented here starting with a brief presentation of the background data on the respondents followed by the extent of collective efficiency and the technology development in the wood based enterprises. The findings on the relationship between collective efficiency (CEI) and technology development (TCI) are then presented.

Background information of the respondents

A sample of 284 wood enterprises was taken from three (3) districts, Nakuru, Kericho, and Uasin Gishu, out of which 203 returned a satisfactory completed research instruments indicating a 71.5% return rate. The majority (74%) of the wood enterprises are sole proprietorship which are mainly furniture production enterprise followed by sawmills with very few panel production enterprises. There has been a steady increase in the number of wood enterprises with time with most started between 2000 and 2006. The majority (71%) of the wood enterprises are aged between 1 and 10 years. The respondents (wood enterprises owner/managers) were fairly youthful with a mean age of 37.12 years with most (35.5%) aged between 31 to 40 years. On gender, women participation in the wood industries sector is low (6.4%). It was noted that in the wood industries, the difference in performance by gender is not significant at the 95% confidence level with the male owned enterprise having a mean $\bar{x}$ = 0.1771 and those female owned enterprise with a mean $\bar{x}$ = 0.1531% of the wood enterprises growth index.

On marital status, the majority (84.7%) of the owner/managers are married with the respondents hesitant to indicate the number of children and other dependants which would be a measure of their family responsibilities.

Collective efficiency in wood enterprises in Kenya

The broad objective of this study was to investigate the relationship between collective efficiency and technology development and use in wood enterprises in Kenya. The study sought to answer the questions, to what extent is the collective efficiency employed in wood industries in Western Kenya? And test the null hypothesis that collective efficiency does not play a significant role in influencing technology development and use in the wood enterprises in Kenya. The collective efforts (joint action) enquired into included subcontracting, sharing of equipment, networking, quality standards assurance, sector associations, backward and forward linkages and partnerships. On subtracting, the most commonly employed effort is specializing in production of some parts and using others bought in from neighbouring enterprises reported by 31% of the respondents followed by getting others to make some components for an enterprise (24.1%).

On the sharing of tools among wood enterprises, the most common practice is doing work for neighbouring enterprise reported by 41% of the respondents followed by borrowing/lending tools from and to the neighbouring firms (15.8%); using neighbouring enterprises facilities to get some work done (11.3%); and getting neighbouring enterprises to provide services for the enterprise (7.9%). This shows a significant amount of equipment sharing. The most frequently mentioned area of information sharing is on quality (51.2%) followed by market (21%) then technology and production methods in that order. The other areas of networking and cooperation mentioned by the respondent include delivery and expediting supplies (48.3%), sharing industry bulletin and report (21.2%) market information (15.8%) and purchasing of materials (15.3%) among others. On the question of wood enterprises cooperation in ensuring product quality standards, it emerged that the most common collective effort is setting and adhering to certain quality standards in the sector reported (23.6%), collaborating in pricing (21.2%) and checking each other quality performance (19.2%). Participation in wood industries sector association is low with the highest frequently mentioned (9.9%) indicating they participate in industry annual parties, 3% join and contribute towards common market especially export market, 2.5% participate in common annual exhibition while only 2% of the respondents are members of sector/industry association.

On the benefits from backwards and forward linkages in wood industries, the owner/managers do not seem to be clear on them with the majority not responding to the item on what they gain by linking to agriculture, trade, other industries and the service industry. Among those who responded, most (28.1%) indicate they benefit from the Agriculture Industry since it buys their products, provide raw materials (21.7%) and provide food (15.8%) for the wood industry sector. The majority (51.7%) of the wood enterprise owner/managers indicate that the trade sector provides market for the wood industry sector while other industries are seen to provide buildings and materials (3.9%), new technology (3.4%) and competition (3.4%) to the wood industry. The service industry is said to provide education and health services (13.8%) and security 1.5% to the wood industry sector.

A collective efficiency index (CEI) was synthesized from the joint actions presented here. The collective efficiency ranges from 0 to 1 in a continuum and can be and has also been expressed as a percentage thus ranging from 0 to100. The higher an enterprise ranks on the index the more the joint actions it engages in and the more it benefits from collective efficiency. It was observed that the wood enterprises have a very low extent of use of joint actions with an index that ranges from 0.02 to 0.31 with a mean of 0.1029 on a scale of 0 to 1. The majority (99.5%) of the wood enterprises were grouped into very low (0 to 0.25 CEI) collective efficiency quartile. An analysis of variance indicate that there is no significant difference in the level of collective efforts across the various sub sectors of the wood industry, ($F=0.168$, $P=0.820$, and $\alpha=0.05$) but the difference between the means is significant ($F=3.583$, $P=0.030$, $\alpha=0.168$, and $x=0.05$) when examined by location (study districts) with Kericho significantly worse off.

This raises the question, is there sufficient evidence that the collective efforts undertaken, however minimal, benefit wood enterprises? Does the collective efficiency have any influence what so ever in access to technology, technology acquisition and hence the growth and development of the wood industry?

Technology development and use in wood enterprises in Kenya

Technology, the other factor influencing industrial development was measured in terms of education and skills; exposure and experience; production processes and methods used; quality assurance and market niche served. In the wood enterprises in Western Kenya, it was noted that 49.3% of owners/managers have secondary level education with 46.8% of them having artisan level of technical training. The majority 50.2% have acquired training in book keeping. The employees, on the other hand, among the management staff 44.8% have primary/secondary level education with a significant 19.2% having college and university level education. The majority (74.4%) of the junior staff are untrained with most 21.2% of those with technical training having acquired it through apprenticeship. Entrepreneurs in wood enterprises tend to rely more on experience and exposure as opposed to technical training; it was observed that they have a mean of 10.5 years of work experience with the most frequent 29.1% having 5 to 10 years of experience. Most (4.4%) of the owner/managers that had worked elsewhere indicated that they were working as managers before quitting and starting their own enterprises.

The majority do not seem to have received in service training, seminars or workshop despite forest industrial training centre (FITC) having been started to provide such training to the sawmilling sub sector of the wood working industry in Kenya. On production processes and methods, most (29.6%) of the owner/managers indicated they use mass production, 28.6% use custom production methods employing appropriate technology and modern technology in equal measure reported by 27% of the respondents. However, what is referred to as modern technology was what it was when it was installed, not anymore. The respondents indicate they acquired the technology they use through collaboration with technical institution (30.5%) and through training (27.6%). To ensure products quality, the most (39.4%) of the respondents indicated that they carry out raw material inspection while 32.5% carry out work in progress inspection. While 25.6% say they have ISO standards accreditation, only 3% have Kenya bureau of standards (KEBS) accreditation. When all the afore mentioned technology development parameters were pooled together to develop a measure of the technology level used by wood enterprise, a technological complexity index (TCI) was developed, a continuum on a scale of 0 to 1 which show that the level of technology used is low ranging from 0.02 to 0.54 with a mean of 0.148 and a standard deviation of 0.08.

The majority 92.6% of the enterprises lie in the very low quartile of the TCI while 99.1% lie below 0.5 TCI. This shows that the technology employed in wood enterprises is very low. It is also noted that the sawmilling subsector employ higher levels of technology followed by panel products than furniture enterprises with variances of the TCI means significant ($F=5.441$, $P=0.005$, and $\alpha=0.05$). Comparing the study districts, Uasin Gishu has higher levels of technology followed by Nakuru and the lowest is Kericho with the variance between means being significant ($F=41.609$, $P=0.000$, and $\alpha=0.05$).

The relationship between collective efficiency and technological development

The relationship between collective efficiency and technological development was noted to be logarithmic. The logarithmic relationship ($r=0.455$, $R^2=0.207$) is stronger than the exponential relationship ($r=0.406$, $R^2=0.165$) which is in turn stronger than a linear relationship ($r=0.381$, $R^2=0.145$). The log linear model is therefore $\text{Log TCI}=0.797+0.455\text{Log CEI}$ which is the same as $\text{TCI}=6.3(\text{CEI})^{0.455}$.

DISCUSSION OF FINDINGS

The study has established that there is low involvement in subcontracting activities in wood enterprises in Kenya. This however shows a significant effort towards subcontracting but absence of a clear policy in support of subcontracting among SMEs is notable. Kimura (2002) notes that in some industries and countries such as Taiwan and Korea subcontracting is done through historical background and detailed structures that are significantly different because of different initial conditions and that in the firm, the pattern of subcontracting is closely linked to the pattern of firm size distribution. On the sharing of tools among wood enterprises, a significant amount of equipment sharing has been established. Sharing of tools is not uncommon in LDCs. Osinachi (2004) indicates that firms in Nigeria build a learning network mainly to improve their performance through sharing of tools, cost of transporting raw materials and information.

Information sharing has also been shown to be minimal. This suggests that deliberate efforts should be made to facilitate information sharing among SMEs, which again can be achieved through careful infrastructure planning and development with the aim of bolstering this type of collective efforts and gains. In Nigeria, the Chamber of Consumers and Industry provide business information for the firms and work with local manufacturers association to organize local trade fairs whose effect, Osinachi (2004) observed is measured by increased technology transfer, improved methods, enhanced productivity and increased rate of wage employment. Bravtigarn (1997) notes that sharing of technical knowhow and skilled workers are benefits gained by small firms clustering in developing countries since individual firms cannot alone afford the cost of high technical skilled workers or invest in capital goods. When professional organizations are structured at micro-regional to macro-national levels, it provides them with commercial, political; information and contacts with other experiences and access to technical advice.

On the question of wood enterprises cooperation in ensuring product quality standards, it emerged that the most common collective effort is setting and adhering to certain quality standards in the sector, yet, there are no structures on the ground to show that this takes place as a deliberate collective effort in Kenya. What this portends for the wood industries in developing countries is that, not only is it threatened by failure to meet quality standards for the export market but even the local market will be lost to imports due to better quality and lower prices as a result of better technology that results in efficiencies and lower production costs. Consequently, SMEs have to shift focus to verifying the quality control process and the quality values installed in each enterprise at every stage of the production process as noted (Nadvi, 1999; Kaplinsky and Readman, 2001). Participation in wood industries sector association is low. ILO (1986) observed that relative public and private institutions have to play an active role in complementing participants in SME development activity. Increasing the number and spread of SMEs through society would result in a large constituency of SMEs owners and employees who have increased understanding of the development potential and needs of the country.

The potential usefulness of trade associations and a gradual realization that strengthening them is necessary for government's promotion of SMEs to be more effective in taking root. The United states has the World's largest SME representative body, national federations of independent business (NFIB) with membership of over 500,000, the association of self employment (BDS) in Germany has more than 500 employees while in Japan, organizations representing small firms are not prominent but political parties usually have a small enterprise affiliation scheme (Hunt, 1986). In Kenya, the federation of Jua Kali Association is a national body with membership drawn from all districts Jua Kali Associations, yet the wood enterprises owner/managers have not shown to be members. In planning and developing infrastructure for small manufacturing enterprises in developing countries, it is important to recognize the role of sector of associations and SMEs in indigenization of the economy, participation of locals in economic activities of a country and the desire for government to be seen to be doing something, promotion and preservation of local culture for political stability, cultivating enterprise culture in society by appropriate political systems and the use of SMEs as a wheel to control the economy locally (ILO, 1986).

On the benefits from backwards and forward linkages in wood industries, the owner/managers did not seem to be clear on them and low a proportion indicated that they benefit. This indicates a significant role played by other sectors in the survival and growth of the wood industry sector but more so, the lack of systematic efforts in support of backward and forward linkage between sectors and firms. Powers (2004) point out two ways an industry can be linked to manufacturing, through purchases of manufactured inputs and through sales of intermediaries to manufacturing firms. SMEs gain from forward and backward linkages and there is need to support backward and forward links. On the whole, the study has shown a low extent of involvement in collective efforts by wood enterprises in Kenya. When technology is measured as a function of education and skills; exposure and experience; production processes and methods used; quality assurance and market niche served it was noted that the levels of education and training is low. This, compared to India, where technical training is considered to be acquisition of a college diploma or university degree in a specific field and technical training as a significant feature of entrepreneurship (Bala et al., 2003) indicates that a lot need to be done in Kenya.

Bala et al. (2003) notes that among SMEs in India, 70% of entrepreneurs in auto, 69% in electronic, and 81% in machine tool SMEs are technically qualified. The majority indicated that they have not even received in service training, seminars or workshop in spite of the fact that the forest industries training centre (FITC) located in the study area was started to provide such training to the sawmilling sub sector of the wood working industry. ILO (1991) indicates that wood products industry has potential to apply state of the art technology and that skills demand, employment and training policies need to be changed to meet current and future requirements. In South Africa, a lot of efforts are being made to address skills demands in the wood industries sub sectors yet shortage of artisans and associated skills are still a significant constraint in the forest products sector (Pogue, 2008). Korhonen (2006) summarizes this observation by noting that the better a company is able to combine investments in knowledge attainment with corresponding investments in new production technology, the better it is prepared for sustainable and profitable growth. On production processes and methods, most of the owner/managers indicated they use mass production employing appropriate technology and modern technology in equal measures. However, what is the respondents referred to as modern technology was what it was when it was installed, not anymore. The industry is technologically dynamic with rapid changes driving competition in the global market.

While the respondents indicated they acquired the technology they use through collaboration with technical institution and through training, this emphasizes the role of institutions of higher learning in acquisition of technology and technological development. The data does however reveal lack of a systematic, planned and supported approach in technology development, acquisition, transfer, and diffusion among wood manufacturing enterprises in Kenya. As EPZA (2005), observes the majority of small scale saw mills in Kenya use old and inefficient machinery, where tractor engines, electric motors and saws are mostly used and where labour intensive methods are used in logging and loading of timber. On wood products quality, it was noted that no systematic, planned and coordinated efforts are made to ensure quality across the subsector. Adoption of current technologies would ensure quality products as specified by customers, furniture products, and saw millers (EPZA, 2005) as noted by Taylor and Guo (2006) who indicate that in China, the furniture industry is on upward trend because of various levels of imported technologies and quality controls introduced and used in wood industries. With low, unsystematic quality control efforts, it was not surprising that the majority of the wood enterprises sell their products to local direct consumers.

The experience in South Africa is somewhat different from that of wood industries in Kenya with value adding industries such as pulp consuming the bulk (70%) of local timber resources and accounting for 66% of primary processing output by value (Pogue, 2003; FSA, 2006). South Africa exports the bulk of its pulp to Asia but has to continue improving its technology so that comparative efficiencies with low cost pulp producers like Brazil do not preclude it from the Asia market where it should operate on a large scale (Chamberlain et al., 2005). What this portends for Kenya is that, unless the wood industry is able to compete effectively even for the local market, it may lose out to the more efficient low cost wood product producers. On the whole, the study has established that the technology employed in wood enterprises in Kenya is very low. It has been noted that incorporating new technology would not only increase product quality but also re-engineer the wood using alternative raw material to produce export quality finished wood products at lower costs (Taylor and Gau, 2006). In Finland, investing in up-to-date production process technology was considered to be an operative imperative in the wood industry requiring huge expenditure for developing the knowledge base (Korhonen, 2006). Korhonen (2006) suggests that wood industries have to develop a dual strategic focus – combine leading edge innovative solutions with cost efficient large scale production. This simply indicates that the survival and growth of wood industry is still a challenge to developing and developed countries alike but a nightmare to less developed countries where the majority are SMEs who have no capacity or muscle to develop, acquire and use modern technologies in isolation without external support. This poses a serious challenge to infrastructure planners and developers since the models that seem to work in developing and developed countries can no longer apply in less developed countries.

The sustainability of industrial development in the long run lies in the support given to local small manufacturing enterprises to access the necessary infrastructure that supports technology acquisition and development through innovation, transfer and use among SMEs. In conclusion, the study has shown that the extent of use of collective efficiency among wood enterprises in Kenya is very low. The level of technology accessed and used is also low which inhibits the development of the sector. There is a significant logarithmic relationship between the collective efficiency and technology development in the wood enterprises in Kenya. This indicates that collective efficiency influences wood enterprises technology development rapidly initially before levelling off after which technology development in an enterprise is less influenced by collective efforts. At this point in an enterprises life cycle, it would have developed enough to be in a position to influence its own technology needs and strategic direction. It is recommended that in infrastructure planning and development in LDCs, there is need to recognize the potential of SMEs and the role they can play in the industrialization process and hence come up with policies that support them in the initial stages by enhancing exploitation of collective efficiency.

Consequently, collective efficiency, networking, systems approach and constructivism should be used as the paradigms informing infrastructure planning and development in LDCs that support technology acquisition, transfer, diffusion and development among SMEs which would then facilitate enterprise growth and their participation in sustainable industrial development.

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