LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

Faculty of Technology Management

Department of Industrial Management

Juha Kiuru

COMPETENCE DEVELOPMENT AND CAPACITY BUILDING OF SAWMILL ENTERPRISES IN KENYA – A HUMAN RESOURCES DEVELOPMENT APPROACH

Examiners of the thesis: Docent, Professor Hannu Kärkkäinen

Senior Lecturer, Project Manager Jorma Papinniemi

ABSTRACT

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Competence Development and Capacity Building of Sawmill Enterprises in Kenya – A Human Resources Development Approach

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The Kenyan forestry and sawmilling industry have been subject to a changing environment since 1999 when the industrial forest plantations were closed down. This has lowered raw material supply and it has affected and reduced the sawmill operations and the viability of the sawmill enterprises. The capacity of the 276 registered sawmills is not sufficient to fulfill sawn timber demand in Kenya. This is because of the technological degradation and lack of a qualified labor force, which were caused because of non-existent sawmilling education and further training in Kenya. Lack of competent sawmill workers has led to low raw material recovery, under utilization of resources and loss of employment. The objective of the work was to suggest models, methods and approaches for the competence and capacity development of the Kenyan sawmilling industry, sawmills and their workers.

A nationwide field survey, interviews, questionnaire and literature review was used for data collection to find out the sawmills' competence development areas and to suggest models and methods for their capacity building. The sampling frame included 22 sawmills that represented 72,5% of all the registered sawmills in Kenya. The results confirmed that the sawmills' technological level was backwards, productivity low, raw material recovery unacceptable and workers' professional education low. The future challenges will be how to establish the sawmills' capacity building and workers' competence development.

Sawmilling industry development requires various actions through new development models and approaches. Activities should be started for technological development and workers' competence development. This requires re-starting of vocational training in sawmilling and the establishment of more effective co-operation between the sawmills and their stakeholder groups. In competence development the Enterprise Competence Management Model of Nurminen (2007) can be used, whereas the best training model and approach would be a practically oriented learning at work model in which the short courses, technical assistance and extension services would be the key functions.

TIIVISTELMÄ

Lappeenrannan teknillinen yliopisto
Teknistaloudellinen tiedekunta
Tuotantotalouden osasto

Juha Kiuru

Keniassa toimivien sahayritysten osaamisen ja resurssien kehittäminen – henkilöstön kehittämisen näkökulma

Diplomityö

2009

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Hakusanat: Oppiminen, osaaminen, ammattitaito, kvalifikaatiot, teknologian kehittäminen, elinikäinen oppiminen ja työssäoppiminen

Kenian metsätalouden ja sahateollisuuden toimintaympäristö on ollut muutosten alaisena vuodesta 1999 alkaen, jolloin istutusmetsien hakkuukielto astui voimaan. Tämän seurauksena sahojen raaka-aineen toimitukset ovat häiriintyneet, sahojen toiminta vaikeutunut ja kannattavuus heikentynyt. 276 rekisteröidyn sahan kapasiteetti ei riitä tyydyttämään Kenian sahatavaran tarvetta, mikä johtuu sahojen alhaisesta teknologiasta ja ammattitaitoisen työvoiman puutteesta, jotka ovat seurauksia alan perus- ja jatkokoulutuksen puutteesta. Edellä mainitut seikat ovat johtaneet alhaiseen raaka-aineen hyötysuhteeseen, resurssien alhaiseen hyödyntämiseen ja useiden tuhansien työpaikkojen menetyksiin. Työn tavoitteena oli ehdottaa malleja, menetelmiä ja lähestymistapoja Kenian sahateollisuuden, sahojen ja niiden työntekijöiden osaamisen ja kapasiteetin kehittämiseen.

Valtakunnallisen kenttätutkimuksen, haastatteluiden, kyselylomakkeen ja kirjallisuus-katsauksen avulla kerättiin tietoa, jonka avulla kartoitettiin kehittämis-alueita ja ehdotettiin malleja ja menetelmiä sahojen kapasiteetin ja työntekijöiden osaamisen kehittämiseksi. Tutkimusotos käsitti 22 sahaa, jotka edustivat 72,5% Keniassa rekisteröidyistä sahoista. Tutkimuksen tulokset vahvistivat, että sahojen teknologian taso oli taantumuksellista, tuottavuus ja raaka-aineen hyödyntäminen alhaisia ja työntekijöiden koulutustaso matala. Suurimpia haasteita ovat sahojen kapasiteetin ja työntekijöiden osaamisen kehittäminen.

Sahateollisuuden kehittäminen vaatii useita toimenpiteitä, uusia kehittämismalleja ja tehokkaampia menetelmiä. Toimenpiteet tulisi aloittaa sahateknologian kehittämisestä ja samanaikaisesti tapahtuvasta työntekijöiden osaamisen kehittämisellä. Tämä vaatii saha-alan ammatillisen koulutuksen uudelleenaloittamista ja tehokkaampaa yhteistyötä sahojen ja niiden sidosryhmien välillä. Osaamisen kehittäminen voidaan toteuttaa Nurmisen (2007) kehittämän osaamisen hallinnan prosessimallin avulla. Koulutusmallina parhaiten toimisi käytäntöpainotteinen työssä oppimisen malli, missä lyhytkurssit, tekninen apu ja suora sahoille osoitettu neuvontatoiminta olisivat tehokkaimpia toimenpiteitä.

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Kotka Finland, May 5, 2009

Juha Kiuru

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ABBREVIATIONS

ECMM	Enterprise Competence Management Model
FD	Forest Department
FITC	Forest Industrial Training Centre
IC	Intellectual Capital
ICT	Information and Communication Technology
KEFRI	Kenya Forest Research Institute
KFC	Kenya Forestry College
KFS	Kenya Forest Service
MENR	Ministry of Environment and Natural Resources
MFA	Ministry for Foreign Affairs of Finland
MF&W	Ministry of Forestry and Wildlife
MMMB	Miti Mingi Maisha Bora
SME	Small and Medium Enterprise
SMEs	Small and Medium Enterprises
SMS	Small and Medium Scale
TMA	Kenya Timber Manufacturers Association

DEFINITIONS

Adult education; means adults and their education. Any educational process undertaken by adults, including vocational education and education taking place outside of the institutional framework, such as a sawmill environment. (Jarvis 1995, 22.)

Competence; means an individual's ability to perform tasks and work, improve and develop work and the workplace and to solve problems related to them. Competence is a combination of personal knowledge, skills and abilities. Competence is a growth in potential of the individual, team, enterprise or collective.

Contextual learning; is a learning process where learning is created from experiences. It is reality based within a specific context, which serves as a mechanism for learners to utilize their disciplinary knowledge to develop their professionalism or occupational competence.

Expert and professional; an expert is a person who has special skill or knowledge in some particular field (Webster's Encyclopedic 1989, 502). A professional is a person who is engaged in one of the learned professions (Webster's Encyclopedic 1989, 1148).

Know-how; "Knowledge of how to do something, faculty or skill for a particular activity" (Webster's Encyclopedic 1989, 793). Know-how means an individual's ability to carry out or perform working tasks, improve work and solve problems individually and effectively. Know-how can also be of organizations' or teams' know-how. (Otala 2008, 47).

Knowledge; Knowledge is often contrasted with skills, attitudes and values. It means 'knowing how' and is connected to the skills that define that a person knows how to execute a task, assignment and a work as a whole. (Lawton & Gordon 1993, 108.)

Learning at work; is understood as a natural learning process of a human being and organization, which normally happens through reflection of experiences. Learning at work means youngsters' and adults' acquisition of occupational competences, occupational development and occupational growth through practical working assignments in a real workplace (Väisänen 2003, 7-8).

Occupation or job profile; specify required occupational competences, standards and qualifications of work that are prepared in accordance with the real working society needs. It is information, which is gathered on work qualifications versus occupational profile.

Occupational competence; Means individual's competences as part of human capital that consist of one's knowledge, skills, experiences and abilities to co-operate and work together with other competent people and one's attitudes and willingness to continuously learn new competences. It is a combination of many professional skills and it is wider concept than professional skill. It can be connected to individual, team or enterprise.

Occupational renewal; is be seen as a continuous, lifelong learning process through which individuals are developing and improving their occupational competence.

On-the-job learning / On-the-job training; Learning or training at work, which is often used in adult education. Work-based learning means more about students' learning at work or worker's learning at their working place. (Väisänen 2003, 6.)

Professional skill; means know-how, skills, competences and successful execution of work as specified and standardized in the working society requirements (Hanhinen 2009, 25).

Qualifications are those work elements or requirements that a worker needs to master according to given requirements by working society, the organization or enterprise (Nurminen 2007, 85-87).

Reflective learning; is not directly connected to the context of work, but to change of perspectives through the regeneration process, which is critical and reflective that affects not only a person's action, but also the structures of knowledge, assumptions, values and beliefs of a human being (Järvinen, Koivisto & Poikela 2002, 96-97).

Technological development; is combination of new and appropriate technology transfer combined with enterprise's and individuals' competence development on know-how, professional skills and occupational competences. Institutional, enterprise, technological and human resource abilities play a vital role in this process.

1 INTRODUCTION

Forestry and wood industries play an important role in global environmental sustainability, and in the creation of employment opportunities and the development of rural areas, which all contribute to the welfare of people in any society. The background for this research work is the author's long-term personal work experiences in Africa and interest in developing forestry and wood technology education and training systems, wood industry enterprises and the management and development of capacity building and human resources programs in developing countries. These aspects and considerations were also an impulse for the initial discussions held with the representatives of the Kenya Forest Service (KFS) and Niras Finland Ltd in Finland, who are implementing a forestry development project in Kenya. In this project forestry development is the main component, however it also includes the development of Small and Medium Enterprises (SMEs) in sawmilling. An important aspect in this development process was to find out the existing competences and training needs of the sawmills, which became the main objective of this thesis work.

The main premises selected for the study and analysis in this thesis work were the Kenyan sawmilling industry, the sawmills and the sawmill workers. The studies included analyses of sawmill technologies, workers' competences, professional skills and occupational qualifications. The study was essential and relevant, because sawmilling work and sawmill occupations keep changing rapidly with the technological development of the sawmills.

The theoretical framework of the thesis was set as sawmill workers' competence development through the development of sawmilling vocational education and adults' further training in Kenya. This was based on: the Andragogical Adults' Learning Theory, introduced by Knowles; the Contextual Learning Model developed by Kolb and Poikela; and the Enterprise Competence Management Model (ECMM) developed and introduced by Nurminen. The theories of the education of adults, adult learning, competence development, occupational growth and enterprise development of Ruohotie, Järvinen, Poikela, Jarvis, Kolb and Knowles were also studied as part of the literature review.

This thesis work presents the results, discussions, conclusions and recommendations of the research and empirical field survey that were conducted from September 2008 to March

2009 in Kenya and Finland. The field survey covered the 22 sample sawmills in the three selected provinces and their ten districts in Kenya, where the total sawmill population was the 276 registered sawmills. The field survey also included another eight institutions that were closely involved with and operating in forestry, sawmilling, research and education.

1.1 Background and Reasons for the Research

Co-operation and relations between educational institutions, private enterprises and working society as a whole are recognized to be the most important factors in developing enterprises and their business performances. The development of these activities has also been recognized throughout the global working society in all parts of the world.

> "The private sector has become the central focus for the economic development of African countries in recent years. It should be kept in mind that the development of the private sector must always be seen in the context of the overall business environment. Private sector development will have to progress in a manner consistent with the conditions existing in each country." (Kennedy & Hobohm 1999, 9.)

The forest and wood industry sectors in Kenya are currently going through a transition stage. This dates back to the partial presidential logging ban in State forest plantations introduced in 1999, which was introduced due to the lack of control and irregularities in the management of State forests. The ban has had several negative effects on sawmilling. The main feature of the success in the Kenyan forest industry had been the constant supply of raw materials to the wood industry enterprises, particularly to sawmills, which represent about 62,5% of the annual production capacity of the wood processing industry in Kenya (Mbaabu, Otieno, Muriithi & Ihure 2008, 2).

In order to improve the viability of the whole forest industry sector in Kenya the Kenyan government is now considering, through the Board of KFS, to withdraw the existing logging ban. The recent Forest Act 2005 and the subsidiary regulation developed under the act outlines the procedure for obtaining the raw material from State plantations through bidding is either for timber licenses or concession arrangements (Republic of Kenya 2005,

270). To be able to participate in the bidding process entrepreneurs have to go through a pre-qualification process where their legal, technical and financial capacities are assessed by the KFS's professionals. The KFS started this pre-qualification process for sawmills in 2007. In the course of this process the KFS examined and monitored sawmills and their business viability in order to issue them with a recognition certificate and registration.

Part of this pre-qualification process should also have been an appraisal and monitoring of competences and the knowledge and professional skills of human resources, predominantly in subject areas relevant to sawmilling. Another aspect for pre-qualification should have been the number of qualified workers working in the sawmill enterprise. Thirdly, to pass the pre-qualification the sawmillers should know and understand appropriate sawmilling technologies in order to apply and execute environmentally sound forest resources utilization and effective sawmilling operations. These aspects however were not studied comprehensively by the KFS. Therefore, this research was significant and right on time.

This research was also applicable for two further reasons. Firstly, that the Kenyan government is presently considering withdrawing the existing logging ban. Secondly, the study on Analysis of Policy: Regulatory and Fiscal Framework for Small and Medium Enterprises Development in Sawmilling carried out by the KFS recommended that:

1. The KFS Board, in consultation with the Kenya Timber Manufactures Association (TMA), should identify and introduce appropriate sawmilling technologies to improve the sawmilling industry.
2. The KFS, in collaboration with the relevant stakeholders should establish a technology transfer and capacity building framework to enhance the performance, capabilities and competences of the sawmills and their workers.
3. The KFS, the Kenya Forestry College (KFC) and the TMA sawmills should plan and develop capacity building and competence development programs. (Wamukoya & Ludeki 2007, 67.)

Another significant pre-consideration that supports the importance of this research work was is the fact that in Kenya there is a big need to re-organize formal education and further training in wood technology, particularly in sawmilling that was stopped in 2000 as a consequence of the logging ban of 1999. The training institute that was closed down was

called the Forest Industrial Training Centre (FITC) in Nakuru, which provided training in sawmill technologies, sawdoctoring, mill maintenance and production management.

1.2 Research Problem Definition, Objectives and Limitations

The Kenyan sawmilling industry, particularly small and medium scale (SMS) sawmilling, has been significantly weakened over the past ten years. The reasons for this are the logging ban, lack of proper innovation and technology policies for the wood industry sector, the absence of appropriate development strategies and lack of vocational education and further training in sawmilling.

SMS forest-related industries, in particular SMS sawmills, provide large numbers of jobs and have the potential to significantly improve livelihoods in rural areas, where the opportunities for work are known to be less than in urban areas. It is estimated that the forestry sector, forest industry and other associated enterprises and industries support more than 14,000 households through formal employment. (Wamukoya & Ludeki 2007, 15.)

Over the last ten years the logging ban has resulted in the closure of more than 300 sawmills. This has caused a loss of 30,000 direct jobs in the wood industry sector and more than 100 000 indirect jobs from the forestry sub-sectors. Another fact is that those sawmills that are still operating have reduced their production capacity as to minimize their costs. The average number of staff in SMS sawmills has dropped from 50 in 1999 to five in 2005.

When sawmills lose their employees, they also lose a lot of personal, context-specific tacit knowledge and specific skills and experiences. Abilities to perform sawmilling operations and sawmilling work are significantly reduced. When the qualified and experienced labor force moved out, the sawmills began to face serious problems in their production operations such as with maintenance, saw doctoring and other specialized sawmill work.

At present the sawmills – particularly the SMS sawmills – do not have enough of trained and qualified workers to carry out viable production operations. The sawmills do not have databases of their workers, their basic and vocational education and training, and their experiences. These factors make also the development of the sawmills difficult. Therefore,

it was important to carry out research and analysis on sawmill technologies and training needs of the sawmill workers. Because of the lack of information on workers' competences, capacities and training needs the KFS and the KFC are not able to plan, market and put into practice their vocational adult education and training programs.

This research was restricted to and focused on sawmills and their stakeholder groups. The research included analysis of sawmill technologies, workers' knowledge, skills, competences and training needs. This information will facilitate the KFS and the KFC to begin planning and development of capacity building and competence development of the Kenyan sawmills. With this gathered and analyzed information, better and more suitable vocational adult education programs and their training models can be established.

The Objectives

The objective of the research was to assist the KFS to initiate planning and establishment of capacity building and technological and competence development for sawmills in Kenya. By assisting and developing the sawmills, their operational viability will be improved, through which employment, social and economic conditions of people can be improved, contributing to better living conditions and social welfare of the Kenyan nation.

Longer term aims that can be achieved are an enhanced national awareness and interest in sawmilling entrepreneurship and wood processing, improved development and capacity of sawmills to better utilize raw material resources from the industrial forest plantations and further developed and improved communication, networking and co-operation among the sawmillers. The research will ultimately support the KFS to initiate preparation of:

(a) Human resources competence development for the Kenyan sawmilling industry.
(b) Sawmill technological and managerial development to develop and improve sawmill operations and production and enterprise management.
(c) Vocational adult education and further training in sawmilling and sawmill enterprise management to facilitate improvement of the sawmill workers knowledge, competences and professional skills.

The Research Questions

This research project, field survey in Kenya and the thesis work aimed to collect empirical data and information on the existing situation of the sawmilling industry and sawmills in Kenya and clarify, describe and define the existing and future competences required in the sawmills. This information was the basis for the collection of theoretical background information on occupational competences and their qualifications, on competence development models and learning, and on lifelong learning and learning at work by adults.

Using this theoretical and empirical information as a basis, the options for sawmill enterprise development and vocational adult education and further training in sawmilling were studied, analyzed and discussed. This was made in order to prepare suggestions on capacity building and competence and technological development of the sawmill enterprises in Kenya. In this context the main research question was set as follows:

What are the needs and requirements for the management of sawmill enterprises' capacity building and their workers' competence development in Kenya?

To inform the establishment of the research and enlighten the main question the following sub-questions were set up:

- *What is the present technological stage and level of competence at the sawmills?*
- *What are the main production constraints and other limitations of the sawmills for developing their business?*
- *What are the current educational levels and standards of occupational competence of the sawmills' personnel?*
- *What is required for strengthening of the sawmill enterprises' capacities to increase their productivity and to improve sawmills' competitiveness and business viability?*
- *What are the means, methods and techniques for workers' learning and competence development?*
- *How can individuals' and enterprises' competence development and capacity building be organized?*

Objectives for the Data Collection and Empirical Studies

The objective of the empirical studies was to conduct a nationwide field survey, to gather information on SMS sawmill technologies and to find out, clarify and describe workers' occupational competences. The objective of the data collection was to collect information about the training needs, sawmill technologies, infrastructure, machinery and equipment used at the sawmills. Another objective was to collect more information about workers' knowledge, skills and abilities in sawmilling and the sawmill management constraints.

1.3 Research Approach and Methodology

The nature of the SMS sawmills, their personnel, and the conditions of the country, industry and society in Kenya were the special characteristic of this research, which also guided the selection of the research methodology and approach. The research was carried out using an empirical research approach that was combined with qualitative and quantitative research methods. The research was practically oriented, but theoretically established with a strong link to practical experiences of the researcher and his personal observations and continuous monitoring of the actual sawmill conditions in Kenya.

The triangulation implementation method was used in the research to collect the data, to carry out the analysis, to achieve the results and to develop the recommendations. This method provided a solid basis for the research as it facilitated a comparison of the researcher's earlier experiences with personal interviews and observational qualitative data analysis. An inductive approach was used to analyze the qualitative research materials.

The data collection was done during the field survey that was planned and carried out in Kenya in September and October of 2008. This was implemented through face-to-face interviews with the sawmill managers and owners, supported with a pre-structured questionnaire that was asked and filled in by the researcher. The qualitative strategy was the basis for participants' and stakeholder groups' in-depth interviews and observations. It was also used to compose the personal observations and in-depth screening of the sawmills. The literature review, theoretical studies and research report preparation took place in Finland during the period of November 2008 to March 2009.

1.4 Structure of the Thesis

The research reports is divided into five main parts starting with definitions of the terms of adult education and competence development and with an introduction to the background of the research are explained. This part also includes identification of the research problem and questions, a description of the limitations and an illustration of the research methodology and approach. In the second part, chapter two gives background information on the Kenyan forestry sector and the sawmilling industry and chapter three presents the challenges in vocational adult education now and in the future.

In the part three chapters four and five introduce and describe the theoretical framework built up and considerations for the thesis work that were established through a literature review. Chapter four is the main theoretical chapter and it describes first of all the learning at work and adult learning theories that have been selected and used in this thesis as the main theoretical foundation and secondly introduces the terms of occupational competence, qualification and professional skills in terms of adult education and development of sawmill workers' competences. These theories and terms have been looked at from the individuals' and lifelong learning point of views where workers' earlier experiences and adult learners have the main emphases.

In the part four, firstly chapter six describes the research methodology and approaches used in the empirical studies, field survey and report writing. Secondly the research results are introduced in detail in chapter seven. Thirdly final discussions of the research results have been carried out in chapter eight, where also conclusions and recommendations are written and finally the summary is written down and described in chapter nine.

The fifth part includes the four appendices at the end of the report. In these the field survey questionnaire (appendix 1.), list of sawmills visited and interviewed (appendix 2.), letter to the sawmillers (appendix 3.) and a collection of photos (appendix 4.) are shown. The photos illustrate the Kenyan sawmills, sawmilling technology, wood utilization, wood handling and the sawmilling industry in general. They also present few examples of the prevailing sawmilling industry conditions in Kenya.

2 FORESTRY, SAWMILLING AND FORESTRY EDUCATION IN KENYA

"The Forest Sector plays vital roles in the livelihood of the Kenyan population through provision of invaluable forest related goods and services. Forest in Kenya has an important function for economical development, environmental services, and social and cultural values." Kenya, in terms of international rating, is considered as a low forest cover country. Forest resources and industrial activities contribute to the national economy by supplying raw materials for primary wood processing, like sawmills. These operations create many employment opportunities, especially for people living in rural areas. (Ministry of Environment and Natural Resources (MENR) 2007, V.)

Kenya's population has increased by about 20% during the last ten years and is estimated to reach about 40 million by the year 2010. This means increasing pressure on demand for forest products as well as the forest resources, their management, utilization and renewal.

The first forest policy in Kenya was produced in 1963 after which the country has experienced a major decrease of forest area. This has also resulted in a big reduction in the supply of forest products. The new forest policy was prepared in 2006. This policy also addresses industrial forest development and private sector involvement. (MENR 2007, 1.)

2.1 Forestry in Kenya

Kenya has a total land area of little over 58 million ha of which 37 million ha is natural woody vegetation consisting of 2.1 million ha of woodlands, 24.8 million ha of bush lands and 10.7 million ha of wooded grasslands. In 1988 the state industrial forest plantation area in Kenya was 165 000 ha, but due to excessive forest exploitation the area was reduced down to 120 000 ha by 1999. These plantations are located in the Rift Valley, and the Central, Eastern and Western provinces of Kenya. (Ministry of Forestry and Wildlife of Kenya (MF&W) & Ministry for Foreign Affairs of Finland (MFA) 2008, 3.)

During the last decade poor management, illicit felling and encroachment have reduced the plantation areas and their productivity considerably. Forest productivity is 15–25 m^3/ha/year for plantations of fast-growing exotic tree species such as *Pinus patula,*

Cupressus lusitanica and Eucalyptus spp. 50% of the planted areas are cupressus lusitanica, 30% of pinus species, 15% of Eucalyptus species and 5% of others species.

The primary objective of forest plantations is the production of wood raw material and other forest products on a sustainable basis for commercial purposes. Secondly, the development of industrial forest plantations supports the promotion and creation of industrialization and employment opportunities as well as poverty alleviation.

The Forest Department (FD) of the MENR has had the mandate over the forest resources since 1963. Due to political and managerial reasons the transformation of the FD into a semi-autonomous KFS is now taking place. In this transformation the KFS will be responsible for management and administration of industrial forest plantations, overall control and supervision of forest resources utilization, overall control of wood processing operations such as sawmilling and establishment and implementation of training and extension activities in forestry and wood technology.

Establishment of forest plantations in Kenya dates back to the 1910s. Good governance of industrial forest plantations will support and contribute to forest industry operations which consequently will positively affect the viability of forest industry enterprises. Industrial plantations are the main raw material sources of the Kenyan forest industries. The transformation of the FD into the KFS implies many changes in the management of forest plantations in terms of new operational principles, pricing, fees and taxes as well as in the allocation of forest concessions and operating licenses. (MENR 2007, 7-17.)

2.2 Use of Forest Resources

Annual consumption of industrial round wood in Kenya was in 1995 about 330 000 m^3 but by 1997 it was already over 1.0 million m^3. Spears (2005) estimated that the demand for industrial round wood in Kenya will increase from 2.0 million m^3 to 2.5 million m^3 by 2015. 1.75 million m^3 of that is expected to be for sawn timber, furniture, joinery and wood-based panels production while 0.75 million m^3 will be for paper products. (Spears 2005, 3-4.) The main threats to the state industrial forest plantation reserves are deforestation and forest degradation, exploitation, illegal logging, pit-sawing, charcoal burning and forest fires (MF&W & MFA 2008, 5).

After the 1999 introduction of the logging ban, unlicensed ferrying, deduction of timber exportation and unavailability of raw materials for the sector has been on the increase. Various industries like SMS sawmills have suffered as a result of the ban. The unavailability of raw material for sawmills and the consequent insufficiency of raw materials for upstream manufacturers of wood-based products has also resulted in the increased cost of raw materials for the sector. The unavailability of good raw materials has also lowered the quality of sawn timber, since sawn timber is not normally dried or graded.

In the Kenya Forest Master Plan it was indicated that demand for sawn timber in Kenya is projected to grow from 203 000 m³ in 1990 to 537 000 m³ in 2020 (MENR 1994, 19). It has been estimated that for sustainability of the forest resources and wood industry round wood supply the annual allocation should be 1.6 million m³ in total from which 1.0 million m³ should be allocated for sawmilling (Mbaabu, Otieno, Muriithi & Ihure 2008, 2).

2.3 The Wood Industry Sector in Kenya

The wood industry sector in Kenya consists of one pulp and paper mill for paper products, three board manufacturing units that produce plywood and particleboard and 450 sawmills. There is also a factory that produces pre-fabricated houses. In addition to these there are various types of wood further processors like window and door makers (joiners), furniture manufacturers, planer and molder units and a range of other small carpentry workshops. Also, it should be noted that there are still number of primitive chainsaw, mobile saw bench and pit saw operators that are cutting a relatively high volume of round wood into sawn timber. The majority of sawmills are located in the western and central parts of the country. The sawmills are mostly privately owned. (MF&W & MFA 2008, 5.)

The country's paper mill consumes annually about 500 000 m³ of pulpwood and 250 000 m³ of fuel wood. The board manufacturing units consume annually about 200 000–250 000 m³ of round wood. (MF&W & MFA 2008, 5.) When the logging ban was imposed on industrial forest plantations in 1999 the 450 sawmills produced about 200 000 m³ of sawn timber, mainly for the domestic markets. According to the present raw material recovery these sawmills consumed annually about 507 000 m³ of round wood.

2.4 The Sawmilling Industry in Kenya

According to the Kenya Forestry Master Plan the average annual output of a sawmill is about 450 m^3 of sawn timber per annum, which is a normal output volume for similar types of sawmill in Africa. In 1994 it was projected that the total production of the sawmilling industry in 2010 would be about 400 000 m^3 a year, as illustrated in the Figure 2.2. (MENR 1994, 194.)

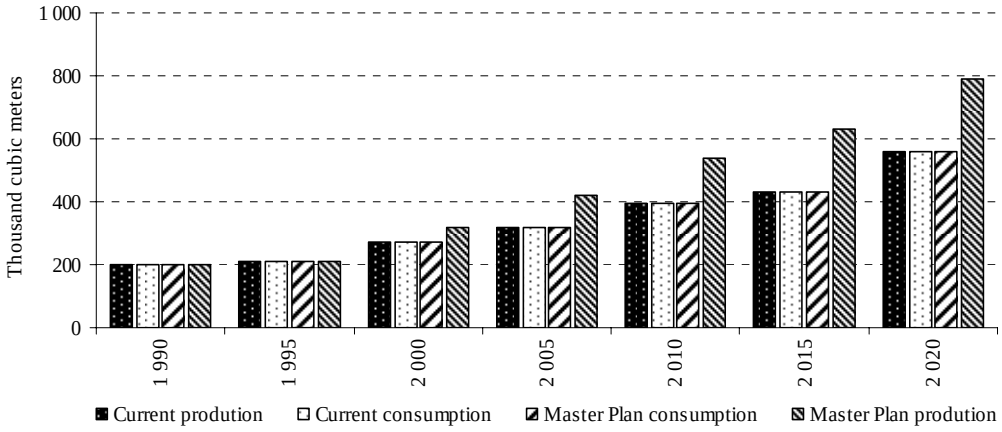


Figure 2.1 Sawn timber production and consumption in Kenya in 1990-2020 (MENR 1994, 194).

Wamukoya and Ludeki (2007) found many issues about the development of SMS sawmills in Kenya. They conclude that the SMEs within the forest sector in particular sawmills play vital role in contributing to national growth and the creation of employment in Kenya. They wrote also that:

> *"The SMEs play an important role in the supply of sawn timber for the construction, fuel wood and associated secondary industry products. The closure of sawmills led to increased unemployment in the rural areas where forestry-related activities were the main economic mainstay of the people."*
> (Wamukoya & Ludeki 2007, 8-9.)

Since the beginning of the logging ban about 300 private SMS sawmills have been closed down due to unavailability of raw materials. During the most active period of sawmilling operations in the mid nineteen-nineties the sector was directly employing about 50 000 workers and was indirectly providing employment for about 300 000 people in forest and wood processing operations as well as in transportation and other supporting services of

the industry. During the logging ban about 30 000 workplaces have been lost. Currently, the sawmilling industry consists of the large sawmills operating under the large wood processing companies, sawmills operated by the tea industry utilizing their own raw material and a few private SMS sawmills that are operating only a minimum capacity. (MF&W & MFA 2008, 21-22.)

The potential annual capacity of sawmills ranges from 500 m^3 to 30 000 m^3 of log input. The most common sawmilling technology has been circular saw technology, although some large sawmills have already changed to bandsaw technologies. Most sawmills have obsolete machinery and equipment, and they use outdated technology. The biggest problem of the sawmilling industry has been the utilization and the recovery of raw material. In the Kenya Forestry Master Plan the main reasons for these were mentioned to be use of thick saw blades, poor cutting practices and unskilled labor. (MENR 1994, 185.)

Following the logging ban the SMS sawmills have faced problems with insufficient raw material supply. They have mainly relied on raw material from the private farms. For more than ten years they have had a problem of competent and professionally skilled labor, leading to low labor productivity and poor product quality. (MF&W & MFA 2008, 21-22.)

A prominent feature of the Kenyan sawmilling sector is also, as with other SMEs in other sectors, a vertical poor connection along the timber value chain. Generally, this means that sawmills and wood processing facilities commonly have their own logging and transport operations in order to get raw material to their production operations. Also in maintenance and other services, that could be provided by service providers, the sawmillers rely on their own work rather than outside service providers. (MF&W & MFA 2008, 21-22.)

Generally, the sawmilling sector is underdeveloped and inefficient. It still uses very labor-intensive working and production methods. There is inadequate knowledge and a lack of competences in plant design, selection of appropriate technologies, equipment and tools as well as in production engineering and plant operations. (MF&W & MFA 2008, 22.)

Following the logging ban the demand for trees and raw material from the farms has increased a lot. This also has increased sawing with less preferred methods like power

saws, pitsaws and locally manufactured simple mobile circular saw benches. These methods are known to be wasteful due to large kerf in the saw. A major problem has been that sawn timber sawing suffered from technological setbacks resulting in low recovery rates, ranging between 23–46%. “The most important factors in sawn timber production are timber recovery, size tolerance and surface quality.” (Muthike 2006, 1-2.)

Raw material recovery is of particular importance of the sawmilling operations. Firstly it determines what tree owners get from their trees. Secondly, the sawyers’ income is based on the amount of timber sawn. In addition, saw blade thickness and saw kerf are the other important factors determining the final recovery and sawing operations economic result. In the study carried out by Muthike in 2006 the recovery differed significantly for the five sawing exercises with different saw blades and sawing methods used. The results were for the power saw 27.0 %, for the bench saw method with a tractor-mounted circular saw 29.8%, for the pit sawing with a two-man hand saw 39.9%, for the circular sawmilling equipment 40.1% and for the bandsaw equipment 46.1%. (Muthike 2006, 1-2.)

The pit sawing was the best sawing model for manual sawing operations and that bandsaws are the best for mechanical timber conversion. However, the most important aspects in achieving higher recovery and improved sawing skills are in particular the training and competence development of sawyers as well as the application of appropriate technologies and equipment for the prevailing conditions. (Muthike 2006, 1-2.)

Sawmilling enterprises in Kenya have their own interest group called the TMA. TMA was founded in 1979 and it represents the primary wood processing industry and its members’ voice towards their stakeholder groups. The main purpose of the TMA is to act on behalf of its members in discussions and facilitation on various sawmilling issues. At present the TMA is nevertheless weak and does not have adequate financing for its activities. Before the introduction of the logging ban almost all (300) small and medium enterprise (SME sawmills were the TMA members. Today however, TMA’s profile is low and it does not have enough active members (only 70). (MENR 2008, 22.) Other facts are that the TMA has no capacity to analyze its member sawmills’ constraints and impacts to their business and it has no capacity and resources to offer any enterprise and business development services for its members (Wamukoya & Ludeki 2007, 23).

In the middle of 2008 the KFS started the first prequalification process for sawmills to qualify them for applying for forest concessions or cutting licenses from the State industrial forest plantations. All 450 sawmills were informed about the procedures, criteria and why the prequalification was implemented. KFS forest officers carried out inspection of sawmills that had applied for prequalification. Out of the 450 sawmills in Kenya, 356 applicants were interviewed and entered into the KFS sawmill database. Out of these 356 276 were recommended as satisfactory with at least a site and basic machinery and equipment, and hence able to participate in bidding for timber licenses. 70% of the sawmills had a capacity of less than 20 m^3 of logs per day. (MF&W & MFA 2008, 17.)

2.5 Forestry Education in Kenya

There are several institutions that organize and offer forestry and wood technology related education and training. The most important organizers and institutions were identified in the Kenya Forestry Master Plan in 1994 and they are as follows:

- Moi University in Eldoret, Egerton University in Nakuru, KFC in Londiani and FITC in Nakuru are offering formal professional and technical education, adult further training and extension services in forestry and wood technology. KFC and FITC are the most important ones in terms of provision of professionally skilled workers, supervisors and managers for the Kenyan sawmilling industry.
- In addition there are various extension service providers of government departments, development projects and other education organizers.
  (MENR 1994, 256.)

1. Kenya Forestry College (KFC)

The KFC was established in 1957 and is the only operational forestry training institution in Kenya that gives technical education in forestry and to some extent in wood technology (MENR 1994, 256). The mission of the KFC is described as follows; “KFC has a mandate to train Technical Forestry Personnel so as to equip the trainees with necessary knowledge, skills and attitudes required to meet the challenges of dynamic Forestry sub-sector and other related sectors and contribute to the economy of the country as spelt in the National Development plan” (Kenya Forest Service 2009).

KFC has a practically-oriented training approach. The training curriculum of the KFC was renewed and revised in 1997. Today the college is conducting a 2-year certificate in forestry course and a 1-year in-service diploma course. In addition the KFC organizes a Basic Forest Guard course that is technically and paramilitary oriented. The college owns 4,000 ha of forest for training and research purposes. (Kenya Forest Service 2009.)

2. Forest Industrial Training Centre (FITC)

The FITC "in Nakuru was established in 1965 for the purpose of supporting the Government of Kenya industrialization policy, by improving the productivity and efficiency of the mechanical forest-based industry". The centre was destroyed by fire in 1975 but through development co-operation between the governments of Kenya and Finland the FITC was re-constructed. (MENR 1994, 257.) FITC has a large-scale production sawmill that is equipped with various types of sawmill machinery and maintenance tools. Due to several political, managerial, and financial constraints as well as lack of raw materials, the FITC sawmill has not been operational since 1999.

An overall plan for the development of FITC training activities was drawn up in 1983. The plan included the establishment of a comprehensive forest industries training facility, with assessed training needs and proposals for training activities. The plan never materialized as such, but at least a smaller training sawmill was established at FITC. This training sawmill together with FITC facilities has all the necessary machinery, equipment and tools to re-establish sawmilling training directed to students of the KFC and workers of the sawmills.

Since 2000 FITC training activities have not been available due to the logging ban set by the Forest Department. During the period of 1965–1999 FITC organized several short and long training courses on sawdoctoring, sawmill technology, sawmill machine operations and other sawmill related subjects. FITC training has been targeted at all levels of sawmill workers. FITC training and services were highly appreciated by the course participants and the sawmill owners and mangers that had participated the training courses. So far the FITC has successfully trained over 1200 Kenyans in sawmilling both in theory and practice. Photos of FITC training facilities are shown in Appendix 4 in the photos 11-12.

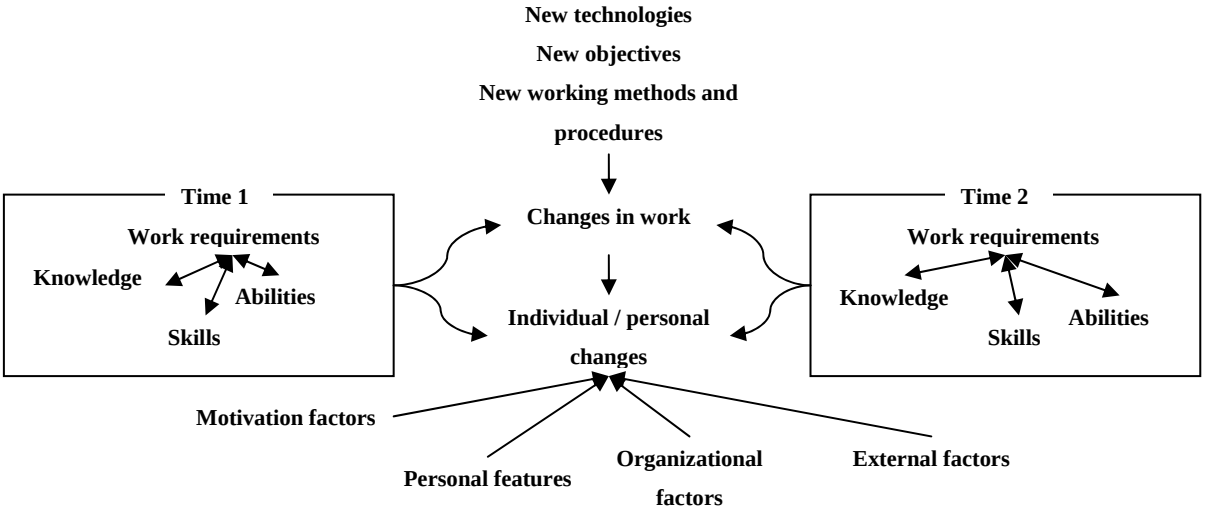
3 PRESENT AND FUTURE CHALLENGES IN VOCATIONAL EDUCATION

The main purpose of this chapter was to establish a picture for a reader about what are the most factors and reasons for improving and developing individuals' competences and therefore the vocational adult education systems and teaching models. These aspects were considered particularly from the context of the Kenyan sawmilling industry. The big challenge is how to gain the full commitment of the sawmill owners and workers, first of all for their own competence and self-development and secondly how to turn individuals' development towards sawmill development process. If a sawmill needs to change its technologies, operations, objectives or processes, learning of new competences is required at the individuals' and enterprise's levels.

Through various researches on technology development and from our experience we know that developing countries, Kenya included, are in a different situation as compared to more developed countries. In some areas they use the latest technology and follow development well. This is the case for instance in Information and Communication Technology (ICT) and mobile telecommunications, which indeed are beneficial the development of developing countries. We also know that in some industrial sectors developing countries are far away from the latest technology. This is the case for instance in the Kenyan sawmilling industry. In these situations some of the enterprises are not willing to educate or develop their personnel because they do not have the right capacity, knowledge and resources. In the Kenyan forestry and sawmilling sectors chancing environment is a big challenge for all the stakeholders, including government, ministries, KFS, KCF, FITC, private enterprises and last but not least people working in the forest and the sawmills.

Continuous changes in the working environment and society are currently so rapid that it is difficult for enterprises and individuals to commit to any particular competence or knowledge development. Steps of changes and development are so fast that sawmills and enterprises are not able to keep up and follow them. They do not have the capacity or resources or they are afraid of failure. Changes in the enterprise environment too often require a fast reaction by the management and employees, which requires also fast and effective competence development at the level of individuals. (Otala 2008, 39.)

Ruohotie (1995) introduced Fossum's and Arvey's hypothetic model, which describes the process of the ageing of vocational competences and the factors affecting to it, as shown in Figure 3.1. The most important factors considered in this model are motivation and external factors coming from individuals, organizations or society. The model shows clearly that setting up or introducing new technologies, new business objectives, new production processes, or working methods and procedures will consequently change work, occupations and their qualifications and requirements such as workers' knowledge, skills and attitudes. These are also challenges for the Kenyan sawmilling industry and sawmills, which soon will face the changing working environment. (Ruohotie 1995, 105.)



(Source; Fossum & Arvey 1990)

Figure 3.1 Factors affecting the ageing of professional skill (Ruohotie 1995, 105).

When considering the challenges and the existing political and economic situation in developing countries, particularly Kenya in this research, we become convinced that there is a lot to be done in the Kenyan sawmilling industry in order to improve enterprise performance, workers' competences and eventually the development of the whole nation. Therefore, we can already conclude that developing countries, including Kenya, cannot follow technological development without reacting to it. Future challenges are various and, therefore, changes in working society depend on various aspects and reasons, including those of economics, administration or human factors. The following six sections will further clarify the challenges that are linked to individuals', enterprises' and to the organizational development activities, even to the development of the Kenyan sawmills..

3.1 Current Level of Knowledge, Skills and Competence

Continuous changes in society, economics and individual behavior are changing customer demand also for SME sawmills. Customers are demanding better quality products, better and more reliable services and faster delivery times for example. All these will have effects on workers' and enterprises' competences also in Kenya sawmilling industry. Workers and enterprises need to adjust their competences so that they can answer customers' demands. This can only be done by continually developing workers' competences, and that can only be done by further developing training institutions and appropriate training programs.

When considering capacity building both at the enterprise and individual levels we should look at the major changes in the business environment. Changes that will affect competence development are: (a) growth of services to be provided for the customers; (b) the increments of intellectual capital needed in enterprise management and the execution of work; (c) change and the development of new technologies and information about them; (d) the complexity of information available; (e) the development of new innovations; (f) automation and computerization; (g) appreciation of qualities; (h) networking, clustering and twinning arrangements in business; (i) better and faster internal and external communication; and (j) competition for markets and customers. (Ruohotie 1996, 9-13.)

The main challenges to having competent workers in the sawmilling industry are new competence areas and changes to occupational profiles, competences and their qualifications. These all are due to technological development, continuous change in work and problems with the physical and mental aspects of work. The basis of today's work and competence development is contained in the following basic assumptions of competence and know-how:

1. They are both individual and communal.
2. They are both a result of educational and informal experience and development.
3. It is not only knowing things but involving a much wider perspective of mastering and executing activities.
4. They mean flexibility, willingness of change and ability to tolerate uncertainty.
5. Their development needs continuous self-evaluation and monitoring of others.

(Helakorpi 2008b, 10).

Mäkinen (1998) states that fast changes and progress in working society require special skills from individuals. For instance willingness for life-long learning and education, further training and self development are required, because work, the working environment, technologies, competences and occupational qualifications keep changing continuously. (Väisänen 2003, 3.) Today's turbulent working environment and speedy technological development require more abilities from the workers than ten years ago.

Technology development increases the need for higher-level professional skills, knowledge and competences. In developing countries like Kenya the future challenge will be how to secure the availability of well-trained and qualified workers. This will also be a challenge for sawmilling training in Kenya, where the KFC and FITC have a role to play.

3.2 Change of the Enterprise Environment

To be successful in enterprise development, like sawmill, is not only a matter of development and the use of new technologies; it is in many respects a result achieved through technological development and improvement of business performance. These can be achieved through changes to and improvement of business processes, organizational structures and competence development. Key issues in this development process are co-operation, partnerships, networking and capacity building. (Helakorpi 2008b, 2.)

Today, the operational environment of enterprises such as sawmills keep changing quickly towards being more dynamic, hectic and unpredictable. This makes enterprise, its processes and product development more demanding. This development requires a lot from capacity building, such as the improvement of production technologies and the competences of the workers. (Koivisto 2004, 6.)

The key question in enterprise development is whether it has the required knowledge and collective capabilities to improve and develop its operations and individual competences. The future success of enterprises in any line of business depends more and more on their workers' abilities and willingness for life-long learning and adopting the new fundamental knowledge, skills and competences important for the enterprise's core business (Helakorpi 2008b, 2). In this challenging environment of change in Kenya the main emphasis should

be given to adult further education, life-long learning, learning at work methods and approaches and comprehensive competence development of individuals and enterprises.

3.3 Work in Transition and Conversion

Work is in transition, as are individuals carrying out their work assignments. There are many expectations and pressures towards individuals. Employers ask them, for example to do their assignments better, faster and more efficiently. They also require the individual to learn new things and change at the same pace as technology development. This is demanding task for individuals and definitely there is a need for competence development.

It is generally assumed that individuals need to learn many occupations during their lifetime. This could, for example be an average of ten occupations. These days, vocational education highlights multi occupations and competences that are equivalent to many occupations, therefore giving more flexibility and opportunity for finding and receiving work. Competence today is much more than just professional competence. It includes also social and communication abilities and skills. (Eteläpelto, Collin & Saarinen 2007, 35-36.)

Today, an employer's expectations about work are directed towards higher competences and more appropriate vocational education and training, productivity and efficiency. A worker's expectations are about quality of work in terms of permanence and flexibility. (Helakorpi 2008b, 3.) Work, job descriptions, occupational competences and accordingly workers' competences and work requirements have changed significantly during the last twenty years when the whole working society has changed (Väisänen 2003, 3). These changes are due to the technological development that has been faster during the last ten years than the previous eighty years. In contrast to the last decade, when occupational competences have been higher and more demanding, the early 1960s and 1970s achieved professional or vocational education was sufficient and accepted for many decades without any need for up-grading or re-education. (Helakorpi 2008a, 1.)

Today's working environment and work itself has a rapid conversion rate to which enterprises, training institutions and individual workers must react. Work and occupational competences are developing quickly due to the innovation of new production technologies

and the manufacture of more complex and fast changing products which also require continuous enterprise's capacity building and efficient human resources development.

Political, economical and national changes are sometimes fast and unpredictable that affect the amount of labor and their competence requirements (Ruohotie 1995, 104). This happened ten years ago in the sawmilling industry in Kenya, when the FD stopped issuing licenses for raw materials used in the sawmills. Many sawmill workers became unemployed and are still without work. Today the KFS have a challenging task to resume issuing licenses for sawmills, particularly to SMS sawmills, which were the most affected by the past decisions made by the FD. Currently the SMS sawmills have also a challenge how to find qualified and trained workers, because there has not been any sawmilling training for about ten years and many of the old workers are not available any more.

3.4 Change and the Development of Technology

Whether technology change and development affects employment, unemployment and the welfare of society have always been important questions for sociologists and researchers. Many people believed that technology development, new innovations, productivity increases and globalization would have been big challenges for the working society and would reduce employment and jobs. This has not happened, even though such development has been fast. In actual fact, technology development and productivity improvement have increased employment. (Vartia &Ylä-Anttila 1999, 1-2.) If the Kenyan sawmills would have been in full swing they could have offered many working opportunities. However after all these years and difficulties this is not possible today, at least without implementing a technology development scheme, through which the sawmills could improve their productivity and therefore increase the employment opportunities.

It is estimated that, in the short term, technology development affects and reduces employment considerably. In the long term the effect is not remarkable because new technologies create new and diverse types of jobs and working opportunities. Noteworthy in this is that new occupations demand more and higher competences as well as new qualifications of workers. Consequently, this means that education and training must be developed and improved in order to meet new competence requirements. This is going to

be a challenge in Kenya where basic and further education in sawmilling technology for both youngsters and adults must be re-established. This process requires good understanding and readjustment abilities from the sawmills, their owners, managers and workers. (Vartia & Ylä-Anttila 1999, 133-134.)

Technology development and changes in technology are the biggest reasons for the outdated knowledge and competences. It is estimated that during next 10-20 years there will be more technological changes than during the history of the world so far. (Ruohotie 1995, 103.) This is going to be the future trend also in Kenya, where production technologies and machinery in forestry and the sawmilling industry will be developed to respond to customers' higher demands for product qualities, environmental protection and to considerations for higher raw material utilization and better productivity in sawmills.

3.5 Technology Development and Qualification of Labor

Hämäläinen (1986) states that people who are ready for continuous self development and education as well as adoption of new technologies can eventually enjoy rewards from the success of innovation and the introduction of new technologies. In particular, people who are ready to further educate and train themselves and have gained good competences through long and specialized working experience will benefit the most from new technologies and innovations. The real problem for experienced and highly educated people is that their knowledge and skills are going to get outdated quickly due to their reluctant attitude towards further and re-education. (Ruohotie 1995, 101.)

Technology development is continuous process that is challenging to the people who work with it. Technology development has many consequences for economic growth, society, people, work, occupations and education. The nature and characteristics of work and occupations are constantly changing. Organizations, enterprises and, more than ever, people using and working with changing technologies need to develop their competences and qualifications in order to achieve the best possible benefit from new technologies. However, it is notable that middle-tier technology sectors such as the mechanical wood industry and sawmilling cannot have such a good impact in this respect (Vartia & Ylä-Anttila 1999, 134-135).

In the sawmilling industry many tasks could be rotated between the workers in order to motivate them and to achieve higher productivity. This approach could also be introduced in the Kenyan sawmills, where most sawmill workers are only able to work in one position and with one machine rather than operating many of them. In any discipline of work the general qualifications for a worker's competence should be as universal as possible to allow the worker to operate in most working positions (Sarala & Hätönen 2000, 12).

In technology development it is imperative that production technologies, processes and working methods are developed and improved concurrently with technology development and transfer. Work itself, the working environment and the safety of workers need to be developed and considered at the same time. Technology transfer is a learning process where certain procedures must be followed in order to succeed. The proceedings should go from the easiest activities to more complex ones (Niossi, Hanel & Fiset 1995, 1816).

3.6 How should Changes in Competence be Managed?

The challenges in work and occupational competence development are about: first of all, how sawmill enterprises can determine their workers' occupational profiles; secondly, how they can analyze the competences required for each occupation; and finally, how the training institutions can receive and utilize this information for the development of relevant education and training programs. To understand this we need to know how human beings and individuals learn at work and in their working environment.

We must know the most appropriate learning theories for vocational and adult educations. We should understand how the enterprise environment and working society influence individuals' learning. We should also know what kinds of competences are required of workers and which qualifications are compulsory for each occupation or type of work.

At present work and individuals are experiencing strong turbulence due to many changes. In many industrial sectors there are big structural changes going on. This is challenging the whole of working society and its individuals. We must be able to move with this changing environment. How and by which means and methods are the key questions. The following two chapters will describe and clarify more about learning and competence development.

4 LEARNING AT WORK AND WORKING SOCIETY

Learning at work is slightly complex term because it has two different meanings depending upon the context in which it is used. In one instance it is used in formal vocational education when students of vocational education institutions do their practically oriented studies in industry or other workplace attachments. It is also used when learning refers to workers' learning throughout their entire work, working society or environment. Learning at work is not only a way of learning new competences, but is also a situation where the needs of a workplace are considered when developing its human resources (Väisänen 2003, 9). In this thesis, learning at work mostly refers to the situation which deals with adults' further vocational education and occupational competence development.

The starting point for learning at work is a problem situation that needs to be solved or improved. Learning at work is based on feedback received from work, monitoring of work processes and, eventually, collective knowledge creation and competence development to improve or develop better and more effective work processes and individual competences. In order to know which type of knowledge and information is required for problem solving and learning we need to go through reflection on experiences, interpretations and analysis. (Eteläpelto et al. 2007, 178- 179.) Learning at work is always necessary when we are working. That can be organised in many different ways with different methods. In the learning process and the planning of it we need to consider at lest learning theories, models of teaching, the people to be taught and their background, competences to be learnt, qualifications required, educational objectives to be achieved and outputs to be processed.

Nowadays, occupational competence does not only depend upon a person's abilities to master mechanically produced and ready made competence models, but it depends more on a person's abilities to perform according to existing requirements, situations and local conditions. Today occupational competences are changing faster than in the past due to the many new technological challenges and innovations taking place in working society. In that process also job profiles, their requirements and qualifications keep changing constantly. In order to meet these challenges we need to develop new vocational education and learning at work training programs to maintain the level of manpower competences. (Ruohotie 1995, 102.) This is because learning takes place in a working context and

occupational qualifications are developed in real working situations at actual workplaces through long-term experience, as real experts are made by working in field situations, for example (Väisänen 2003, 6).

4.1 Learning at Work - What Is It?

Learning at work can be understood as a natural learning process of a human being and organization, which normally happens through reflection of experiences. To organize learning at work is not easy, but a challenging task due to the fact that in most cases learning happens concurrently with normal working activities and routines. It is important to look at and understand the concepts of reflecting and conceptual learning theories and how they relate to an individual's learning and learning at work and to the organization.

Learning of competences is context-specific depending on work, the potential for individual learning and the organizational learning environment. Some work is more learning-intensive than others, because it is more detailed and divided into pieces. This, allows also more effective learning by individuals, on the condition of course that the organizational learning environment is favourable. The learning prospects in simple, repetitive, routine work are lower than for highly complex work. Learning at work can also be learning from experience. This depends very much on the context of the work, the motivation of the worker and on the state of the organizational environment. In other words, it depends on how the organization supports and gives assistance for employees and the development of activities in general. (Loogma 2004, 577.)

Learning at work is understood in many different ways. Varila and Rekola (2003) describe that learning at work means vocational basic education, which is arranged at the working place simultaneously with practically oriented work (Pietilä 2004, 25). Learning at work can be understood as objective oriented, guided and evaluated vocational basic or further education which supports vocational professional studies. In this case the organizer of education or training has the responsibility to organize the favourable learning situation and environment. Learning at work in this type situation is based on agreement between the training organizer and enterprise or employer (Lankinen & Souri 1999).

Kulmala (1998) writes that learning at work can be:

a) A practical part of studies, implemented at a workplace and leading either to a degree, diploma or certificate.
b) Part of apprenticeship training where learning takes place through working at a workplace.
c) Training, which has been arranged and paid for by the employer and is directly connected to the work of the trainee.

Kulmala continues that workers can carry out learning at work practices by rotating both their work and working positions in their working places. (Väisänen 2003, 7, 8.)

Räsänen (2005/2/3) states learning at work occurs in three different stages. During the first stage the learner learns through working and experiencing; in the second stage – the so-called learning at work stage – learning is through further practicing and conceptualizing the work; and in the third stage the learner learns from the work itself through critical work process analysis and development of work. Formal vocational education can be understood as learning for work. This includes an educational path and learning of work requirements required by the working society. (Poikela 2005, 13.)

Otala (2008) states that learning at work for adults means all the different methods where they learn through a learning-by-doing philosophy. These are, for example, work instructions, journeyman-apprenticeships, follow-up of others' work, cross-learning from others, work rotation, changing of work, development of own work, practicing of work, experiments and action learning. Distinct to all of these is that there is much exchange of tacit knowledge, which is held by experienced workers, masters and journeymen. At present, when there is a lot of change in work, occupations and competences learning at work is even more important as it facilitates learning and working at the same time. (Otala 2008, 224.)

Learning at work adopts slightly different meanings depending on the education level at which it is carried out. In adult vocational education programs, like apprenticeship training, learning at work is part of the comprehensive training program leading to a vocational qualification, but not for a certificate or diploma. In adult vocational further training programs, like short courses or skills upgrading courses, learning at work is used only for

improvement of workers' occupational competences. This training will not give qualifications with a certificate, diploma or vocational qualification title, but do give better occupational competences for performing work and may give opportunities in the future for participating in higher vocational education programs to achieve a certificate, diploma or vocational qualification title.

In this final thesis assignment the term "learning at work" was generally used as part of the development of occupational competences without specifying the level of training. However, it should be emphasized that this final thesis was for the most part dealing with adult further vocational education issues.

4.1.1 Learning at Work Theories

Many scientists and researchers have described and defined learning theories at work, working society and organization. Their theories and approaches vary depending on the context in which they look at the learning process. Some theories look learning at work only from the individual's point of view whereas some others describe learning more collectively and as part of organizational learning. There is no doubt that individuals and organizations learn in all situations. Because the context of learning is not that homogeneous and there are several views of learning at work, it is better to look at the three most relevant theories to suite Kenyan prevailing conditions.

Marsick and Watkins (1990) articulate their learning theory as ***learning at work theory***, which is informative and incidental since it is opposite to basic or formal education, which normally takes place in a formal school environment. With incidental learning they refer to learning and the learning situation that happens incidentally during work, in which work defines and leads the contents of learning. This theory is also called supplementary learning because learning occurs by itself such as learning-by-doing. This theory has interesting fundamentals because, if well organized, it will take place at individual, team, organizational and highly professional levels of organization or enterprise. Key aspects for learning are feedback and self-evaluation at each level of learning, which will start new learning processes. Learning at work is always objective oriented and can be organized through problem solving implementation. (Järvinen, Koivisto & Poikela 2002, 98-99.)

Dubin (1990) speaks of ***occupational renewal***, which deals with maintaining, improving and increasing occupational competence, which can be done by absorbing new, updated knowledge to upgrade personal skills and competences or developing new working techniques. The renewal process is a lifelong learning process where personal motivation is an important driver in facilitating abilities to learn new competences and maintain existing ones. Good motivation leads also to the achievement of set working objectives, which will result in extra benefits and bonuses for the workers and which will again get individuals to renew their working process on a long-term basis. (Pietilä 2004, 27.)

Learning at work is part and parcel of work processes. During these processes a worker has an opportunity to learn through observing his or her existing work and work processes and by developing, trying and testing new methods, models and techniques as well as by defining and collecting new knowledge and information for further ***development of work and occupational competences*** as a whole (Poikela 2005, 27). This process seems to be a very practical model for developing and improving work processes and work itself. Important in this process is that enterprise management allows and facilitates personnel to begin and carry on the process continuously. The main aspect of this process is learning from feedback at different levels of working society.

In order to understand learning at work theories and concepts one needs to understand the relationship between reflective and contextual learning. Kolb has written that his model of contextual learning is suitable for any learning situation, particularly to explain an individual's learning process and its relation to the work context. Contextual and reflective learning theories and models have long been known as models for adults' vocational education. They are based on experiences and routines that have their backgrounds in traditions and external authorities. Experiences can lead to reflective actions, which lead to a comprehensive and active searching of beliefs.

4.1.2 Contextual Learning Model

Contextual learning is a learning process where learning is created from experiences. It is reality based within a specific context, which serves as a mechanism for learners to utilize their disciplinary knowledge to develop their professionalism or occupational competence.

Kolb has explained that contextual learning links together education, work and personal development processes. (Eteläpää et al. 2007, 179.)

The starting points for individual contextual learning are the learner's early experiences of work and his or her views created from the experiences. These will guide the learner in the generating and learning of new knowledge and skills as well as creation of occupational competences in long-term professional growth. Self-reflection of the learner is also one of the key elements in the contextual learning process. (Väisänen 2003, 11-12.)

Kolb's contextual learning theory includes the following six key aspects:

1. Learning is observed and considered as a process, not only the final result.
2. Learning is a continuous process based on experiences.
3. Learning is a problem-solving situation.
4. Learning is a comprehensive process to orientate oneself to working society.
5. Learning takes place through interaction with the surrounding working society.
6. Learning is a knowledge creation process.

(Väisänen 2003, 12.)

Kolb's model describes contextual learning in a four stage cycle, where realizing own immediate and concrete experiences is the base (step 1, realizing). This leads to immediate observations and deliberations resulting in reflections (step2, considering). From this the process continues to the understanding of the phenomenon and creation of new knowledge and models for trials and new actions (step 3, conceptualizing) to be followed by learning new skills and occupational competences by try-outs and applications in practice (step 4, experimental action). To learn effectively and create new concepts and own experiences a learner needs to go through all four steps. The key dimensions of Kolb's model are own experiences (step 1) versus conceptualizing (understanding of own experiences and the phenomenon) (step 3) and reflective observation (conversion of experiences) (step 2) versus active action (step 4). (Väisänen 2003, 12.)

Poikela (2005) argues that Kolb describes that reflection takes place in one stage of the complete cycle of contextual learning process while, in his theory, reflection takes place in all four steps of the contextual learning process. Poikela continues that in Kolb's theory

reflection includes only the making of observations and consideration of previously achieved experiences, not all steps of the learning process. According to Poikela, reflection has two dimensions; one dealing with reflections in action (immediate action) and the other dealing with reflections on action (reflection on achieved experiences). (Poikela 2005, 24.) Poikela's contextual learning model is a suggested learning at work model of this thesis. It is explained in more detail under the section 5.1, where the competence development models are illustrated. However, in the section 5.1 this figure 4.1 is used for illustration.

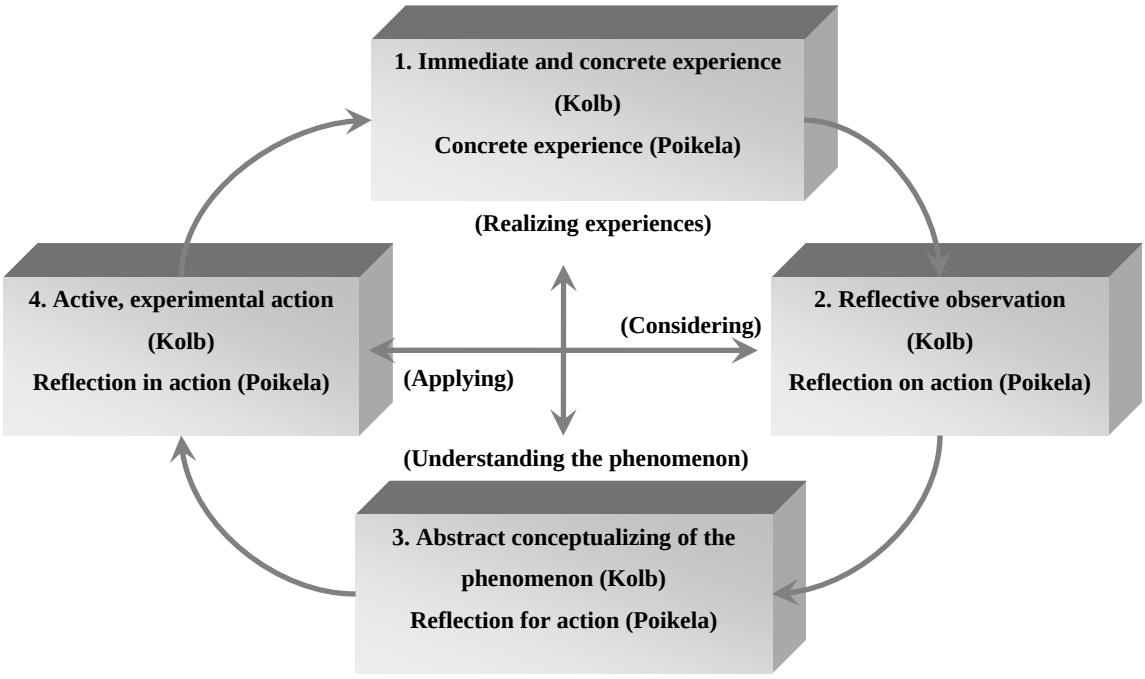
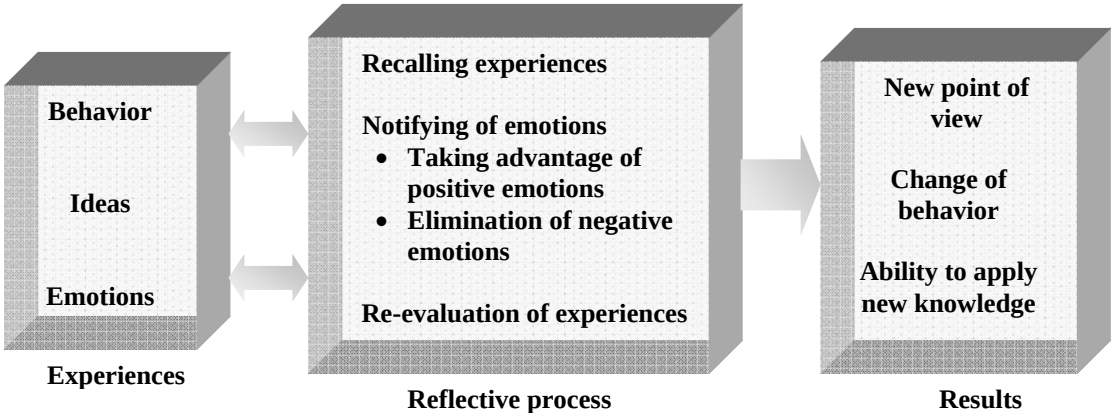


Figure 4.1 Contextual learning model (Kolb 1984, 42) and (Poikela 2005, 25).

Väisänen (2003) argues that there is no effective contextual learning without reflective learning and experiences, and vice versa. Therefore, we need to look at reflective learning theory a little in order to get a full understanding of the contextual learning concept. Generally, reflectivity means that a person is able to make rational selections between different alternatives and is able to decide which one is the best option. Reflectivity is a personal ability, where one can discover different views, opinions and solutions for prevailing situations, activities and operations and be able to justify and adjust them for one's own further learning processes, new actions and concrete new experiences. (Väisänen 2003, 12.)

4.1.3 Reflective Learning Model

Väisänen writes that Boud, Keogh and Walker (1985, 3) are of the opinion that reflection is a general notion for the intellectual and affective activities that guide individuals toward finding new meanings and concepts to change their existing experiences, routines, models and customs. They have said that people have deep-in-thought exercises around their own experiences; they think, observe and develop new concepts from old ones to improve their understanding of existing reality and world views. They have also emphasized that there are three factors that influence reflectivity and the learning process more than others. These are abilities 1) to bring back previous experiences, 2) to go back and perceive their real positive and negative feelings and 3) to re-evaluate and re-consider their own experiences. (Väisänen 2003, 15.) Figure 4.2 describes Boud's and others reflective learning process.



(Source; Boud's 1985, 36)

Figure 4.2 Reflective learning process (Väisänen 2003, 16).

As a conclusion on learning at work theories, we can say that there are many aspects that influence our learning processes, particularly when learning practically oriented work. This is normally a challenge for education planners and organizers in any vocational education or training institution. This is because they need to understand learning at work theories comprehensively, they need to be aware of occupational competences required in different occupations, they need to know which type of qualifications are required for each occupation and finally they must be able to plan and establish appropriate vocational education and training programs for both school leavers and adults working in the real working situations and conditions. In this research, this means sawmills in Kenya.

4.2 Occupational Competences and Qualifications

An interesting point of view in today's enterprise competence discussions is that many researchers and scientists of business management and of enterprise and organization development are describing enterprise competences as enterprises' abilities to act with effectiveness and efficiency. They look only at competences that are directly attached or linked to the abilities and capabilities of a physical enterprise, but not to individuals and their abilities, knowledge, experiences and competences.

In regard to the above one can ask. Who is creating the enterprise's competences? Are they not human beings and personnel of the enterprise? Are the enterprise's physical and human competences mutually the real core competences? Which one of these two is more important in order to maintain the competitiveness and viability of an enterprise?

Otala (2008) states that an enterprise's intellectual capital (IC) consists of three elements, which are: 1) ***human capital***, consisting of people and their competences and willingness to use their competences to meet mutually set business objectives; 2) ***structural capital***, consisting of an enterprise's physical and human structures, technologies, operating systems, methods, working processes and culture; and 3) ***social capital***, consisting of competent partners in the development of new competences (Otala 2008, 47).

Enterprise's IC is a comprehensive definition of enterprise competences including everything that affects the competitiveness and viability of an enterprise. IC is "the possession of the organization's knowledge, experiences, technology, customer relationships and professional skills that provide a company with a competitive edge in the market" (Edvinsson & Malone 1997, 10). This supports the argument that IC means all competences collectively including technology, enterprise, organization and its individuals.

The competence development of enterprise such as a sawmill is a complex issue, in which many aspects need to be considered simultaneously. There are cultural, technological and human resources issues associated with competence development. Another issue that makes competence development even more complex is the fact that we need to examine these aspects at the same time from individual, collective and organizational perspectives.

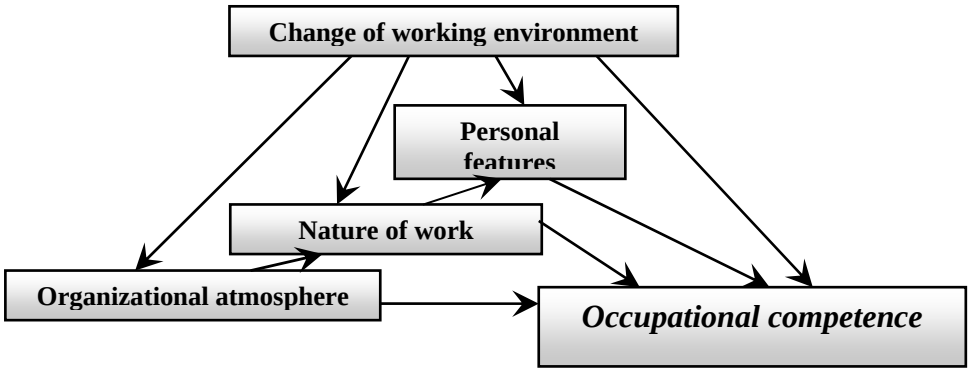
People can be seen as the most important resources and the most valuable assets of any business entity. They make the enterprise live or die. Their competences are what count in the success or failure of an enterprise. With the right peoples' individual competences and development of them, an enterprise like a sawmill can be even more successful.

In order to analyse the factors behind occupational competence and its development we need to know what competence is. An individual's competences as part of human capital consist of one's knowledge, know-how, skills, experiences, networks and abilities to co-operate and work together with other competent people as well as from one's attitudes and willingness to continuously learn new competences. Normally, knowledge and skills have been adopted through basic education, formal vocational education, reading and of course doing things. An individual's personal features are personality and attitudes, which are important parts of competences. Other necessary characteristics are emotional characteristics like motivation, social abilities and innovation. One dimension of individual competences is also the ability to create networks and interactions with other professionals and enterprises. This ability becomes more important every day because professionalism today is more about team work, co-operation and networking. (Otala 2008, 47- 52.)

Occupational renewal and change in occupational competences is a must in today's unstable working environment, where technologies, work and working procedures develop continuously. All these together demand a lot from workers, managers and owners. All of them need to keep up with technological changes and their self-development. Ageing of knowledge and skills in many occupations is a real threat for enterprises and their personnel. Increase of information and knowledge at an exponential speed, complexity of knowledge, technological changes and innovations and global competitiveness and open markets make occupational renewal and competence development necessary. These factors must be considered all the time when developing individuals' and enterprise's competences. (Ruohotie 1995, 101-103.) This applies to the Kenyan sawmills, too.

Occupational renewal should be seen as a continuous, lifelong learning process through which individuals develop and improve their competences. Important factors for continuous occupational renewal are the nature and arrangements of work, leader-subordinate relationships, the organizational atmosphere, relationships generally and

management styles and methods. The most important aspect of all is the enterprise atmosphere. If the enterprise climate is positive it creates positive attitudes amongst the personnel and leads to positive self-development of individuals. (Ruohotie 1995, 122.) The figure 4.3 shows the factors and their relationships to occupational competence within the working community.



(Source; Kaufman 1990)

Figure 4.3 Kaufman's occupational competence model (Ruohotie 1995, 125).

The wood industry sector like sawmills often require from their skilled workers personal qualifications like responsibility, loyalty, attitude and independence. They also perceive that commitment, accuracy, hard work and time-flexibility are some of the features of a competent worker. (Loogma 2004, 579.)

Table 4.1 Concepts of qualification, competence and intelligence (Grollmann 2008, 149).

Qualifications	Competence	Intelligence
• Derived from tasks and challenges in work situations • Can be adjusted through changing the organization and distribution of work • Structure is mainly subject to way work is organized • Often broken down into a large number of tasks • Deals with industrial sociology and work science • Deals with descriptions, task and job analysis, etc.	• Mean individual abilities to solve certain problems in specific situations and work contexts • Can be learned in formal settings or through experience • Structure is mainly subject to intra-individual ways of organizing cognitive resources • Have coherence between subjective abilities, cognitive resources and external challenges • Deals with vocational and work psychology, educational research and human resources development • Is in methodological vacuum	• Generalisable, ability to solve problems in any context • Stable trait, determined to a large extent by biophysical potentials over time • Structure is subject to general cognitive processes • One-dimensional or only few dimensions • Deals with differential cognitive psychology • Uses psychometric testing

The concepts and distinctions between competence, qualification and intelligence are shown in Table 4.1. This table indicates that occupational competence is an intermediate

concept between objectively verified tasks and the abilities needed to fulfill these tasks and a fully subjective view on an individual's intelligence. Grollmann concludes that "the use of the term competence carries major implications for individual processes of learning as well as for the organization of work and occupational profiles". (Grollmann 2008, 148.)

4.2.1 Professional Skill and Requirements of the Working Society

The definition of professional skill should not be confused with definitions for occupation or profession, where certain work is classified as a certain profession. Good examples of traditional professions are, for instance: doctor, lawyer and priest. In this thesis, professional skill, occupational competence and qualifications are treated separately as independent terms. They are considered from the sawmilling industries point of view. Professional skill means the competence to carry out a certain occupational profile which requires a combination of certain basic and professional or vocational education that is required in that advanced named and defined occupational profile.

What is good professional skill? Does it mean that a skillful person, in his or her professional field, can produce nice looking and high quality products, and that he or she is able to repair and maintain them? (Honka, Lampinen & Vertanen 2000, 49.) These types of criteria were valid during the craftsmen's time, when manual and skills on hand methods were the most important features of a qualified worker. Today the situation is different. There are many other factors that influence the competence of workers and the qualification and standards of occupations. There are rarely two workplaces, workshops or sawmills for instance that have exactly the same machinery, production processes or working methods (Honka et al. 2000, 49). Therefore, when workers today change their workplaces they need to learn new competences, work and production processes before they can operate the machinery and work efficiently.

Professional skill is described as the proficiency and skills to do something that has been linked to practically oriented work. A profile of this includes information and knowledge about work orientation, required abilities, required education or training and the competence prerequisites to carry out a comprehensive practical work process and work itself. (Väisänen 2003, 31.) Professional skill is a continuously changing profile that needs

to be upgraded frequently. Professional skill is created through basic education and secondary vocational education, which provides the minimum competence for the work.

Anderson and Marshall (1994) defined three different stages in the learning of the skills needed in working life. These learning stages and their contents are illustrated in Figure 4.4. During these three learning stages people learn different skills. During the first stage, the basic skills and personal abilities required for employment are developed. The second stage is meant for learning and development of individual efficiency features needed for work like knowledge, skills and attitudes. These include professional and generic skills as well as personal abilities. The third stage consists of learning and development of organizational professional skills and occupational competences to facilitate the most efficient, effective and profitable organizational performance, through which all the available enterprise resources are in full use and capacity. (Ruohotie 2004, 24.)

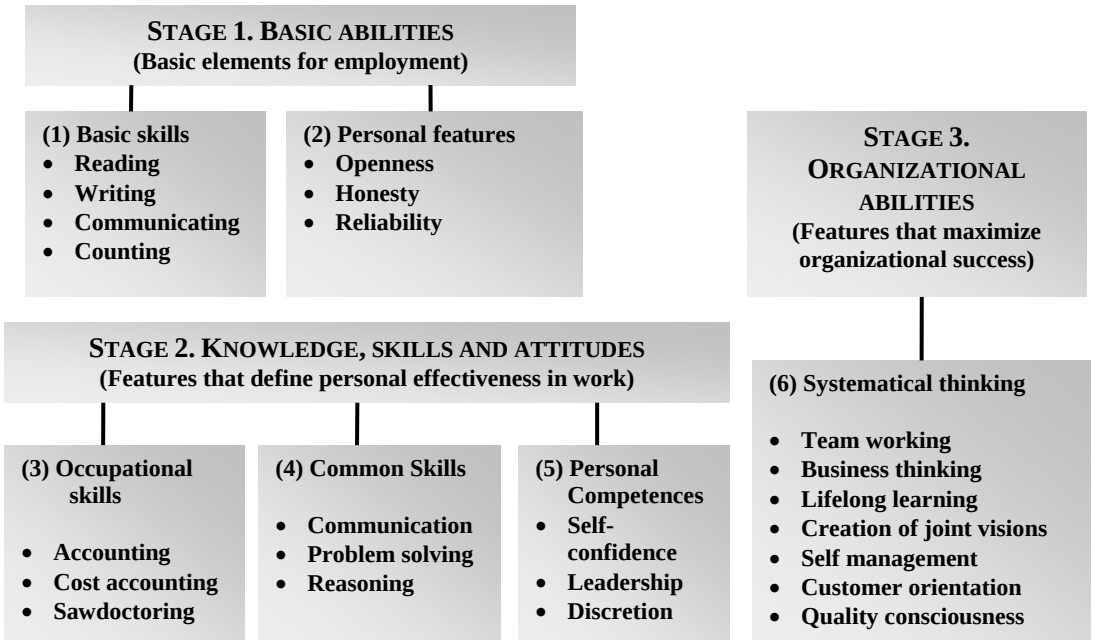


Figure 4.4 Professional skills required in working society (Ruohotie 2004, 25).

Professional skills can be examined either from the employees' or employers' points of view as well as partly from the education organizer's perspective. Professional skill is generated from a person's gift or talent, abilities and competences in a certain field. Professional skill and its standards keep changing when the working environment, work tasks and workplace requirements change. They also change when an individual is self-

developing and personal features are changing. Professional skill is not a combination or sum of certain required skills, but it is an ability to combine and develop an aggregate of knowledge and skills required for a certain occupational profile. (Honka et al. 2000, 50.)

Honka et al. (2000) have listed occupational competence for the following premises of professional skills:

1. *Core skills* are related to technological performance and work execution and they are the most important skills needed in the execution of an occupation.
2. *Supporting skills* are the skills that support the core skills.
3. *Silent skills* are practical and not visible skills which appear after long-term practical experiences (Räisänen 1998, 76).
4. *Hidden skills* are skills that people do not want to share or tell others (Räisänen 1998, 11).
5. *Key skills* are skills that are used for the creation of new solutions for the existing problems in work so they are often attached to problem-solving and decision making (Räisänen 1998, 11).

   (Honka et al. 2000, 50-51.)

Evers, Rush and Berdow (1998) analyzed lifelong learning and skills for improved employment opportunities. They grouped competences and their skills for four clusters as shown in Figure 4.5. (Ruohotie 2004, 26.)

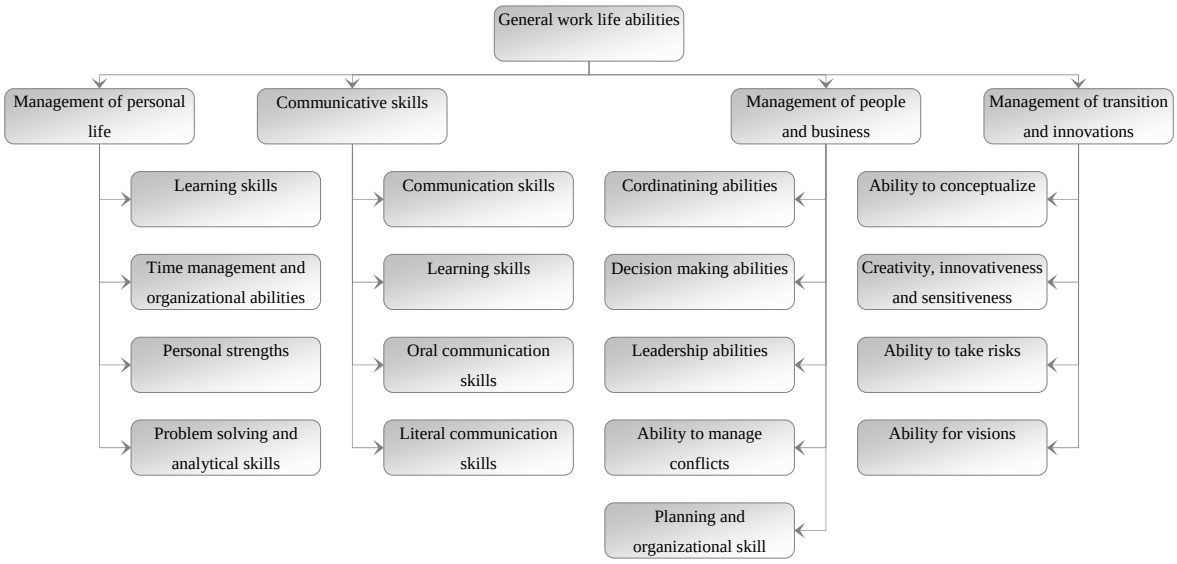


Figure 4.5 Common working life abilities (Ruohotie 2004, 26).

Professional skill is a definition that combines both a worker's occupational competence and the occupational qualifications determined by working society. Professional skill is something that is attached to occupational competence depending on the extent of an occupation, its definition and its contents. (Hanhinen 2009, 25-26.)

Professional skills or occupational competences can be activated from both an individual's and work's point of view. From an individual's point of view, professional skills and abilities form wider occupational competence while a work point of view highlights the working society requirements, standards and the qualifications for occupational competence. (Hanhinen 2009, 29.)

4.2.2 Occupational Competence

When describing and defining the concept of learning at work and occupational competence there are two words that have more weight and meanings than others. These are COMPETENCE and QUALIFICATION. Competence is used when defining broader capacities and abilities of an occupation whereas qualification is used to determine specific criteria and standards for each occupational competence. Competence is also understood more broadly than professional skill because it can be used to emphasize an individual's personality, flexibility and capacity in different contexts and work situations.

In scientific language, particularly when it is used in education theories, it is expressing a person's abilities to do and carry out certain work tasks according to advanced, defined standards and qualifications. With competence we mean that a person understands and is able to master and control all the knowledge and skills required for the work.

Competence is also defined as the mix of human knowledge, skills and aptitudes serving the enterprises' productive purposes and therefore its competitiveness. Competence development is defined as the measures taken by any enterprise to develop its competence base, including human resources and technology. (Isusi 2003, 46.)

Drejer and Riis (1999) write in their article that technological dynamics will influence the competitive dynamics of enterprises. An enterprise's core competences are defined as

those competences that provide competitive advantages. Drejer and Riis propose that competence consists of four generic elements, which are related and linked to each other and should therefore be developed mutually by considering their individual characteristics and the implications for competence development. The elements are as follows:

1. *Technology*, which is the most visible part of core competence representing tools, machines, equipment, software and materials that are physical.
2. *Human beings*, which is the most obvious part of core competence and the use of technology, and also the core of the competence development.
3. *Organization*, which is referred to as formal organizational structure and management systems under which people operate.
4. *Culture*, refers to informal organization and corporate culture that influence people via values and norms guiding activities and operations.
   (Drejer & Riis 1999, 632.)

Occupational competence can be achieved only with the right combination of education and practical work experiences. Education gives basic knowledge and competences, which must be strengthened by practical work experiences. Only this combination will give the qualification of a professional expert in a certain occupation. (Honka et al. 2000, 51.)

Competence is created and born when know-how and work (doing) are combined. This defines that occupational competence is a combination of personal knowledge, skills, abilities and competences. Competence is a growth in potential of the individual, team, enterprise or collective. This potential for performance is based on an individual's continuous self-development process and cognitive abilities. (Hanhinen 2009, 25.) The following are the characteristics of competence, which is often called as occupational competence:

1. Competence is directly attached to the actions and doing of things.
2. The core elements of competence are knowledge, skills and abilities.
3. Competence is the potential capacity and resources that facilitate the doing.
4. Competence can be associated with both individual and enterprise features.
5. Competence is relative and context bound.
6. Competence is a qualitative feature that can be described, measured and evaluated with quantitative terms.

7. Competence obtains a meaning when it is linked to objectives, strategy and work or its assignments.
8. Competence is dynamic – often understood as process oriented - so it can be used, developed and changed respectively, giving enormous opportunities for individual and enterprise development.
   (Hanhinen 2009, 40-42).

Sarala and Hätönen (2000) have produced a list of a working society's future requirements for occupational competences. They stated that a change of working society and environment will definitely require new competences. The following know-how and skills are the most important future requirements for occupational competences:

- Management of resources: to identify, plan, organize, and distribute physical and intellectual resources.
- Co-operation and networking.
- Acquisition and use of information and knowledge.
- Administration and mastery of communication.
- Acquisition, development and utilization of appropriate technologies.

Competence can be considered from many different angles and perspectives. It can be related to individuals, technology, business, marketing, co-operation, networking, organizational knowledge, skills and abilities. Competence can be seen as the individual's abilities for occupational and self-development or as the organization's abilities to develop its operations, knowledge and skills of its individual members. (Henttonen 2002, 18.)

Individual and organizational learning has often been examined from the learning organization point of view. Individual learning objectives are often linked either to work itself or to personal development needs. Individual learning does not necessarily make an organization learn, although a good learning organization environment and atmosphere, if well managed, facilitates both learning for the individuals and organization.

The individual competence of an expert can occur through intellectual or physical performance. It can be connected to technological and social relationships. Nowadays, communication skills, learning abilities, tolerance of change and specialties are competences that mean a lot when defining competences. Figure 4.6 shows one perspective

how occupational competence is structured and what main factors influence and affect professional skill, abilities, expertise, life management and eventually occupational competence as a whole (Helakorpi 2008 a, 4).

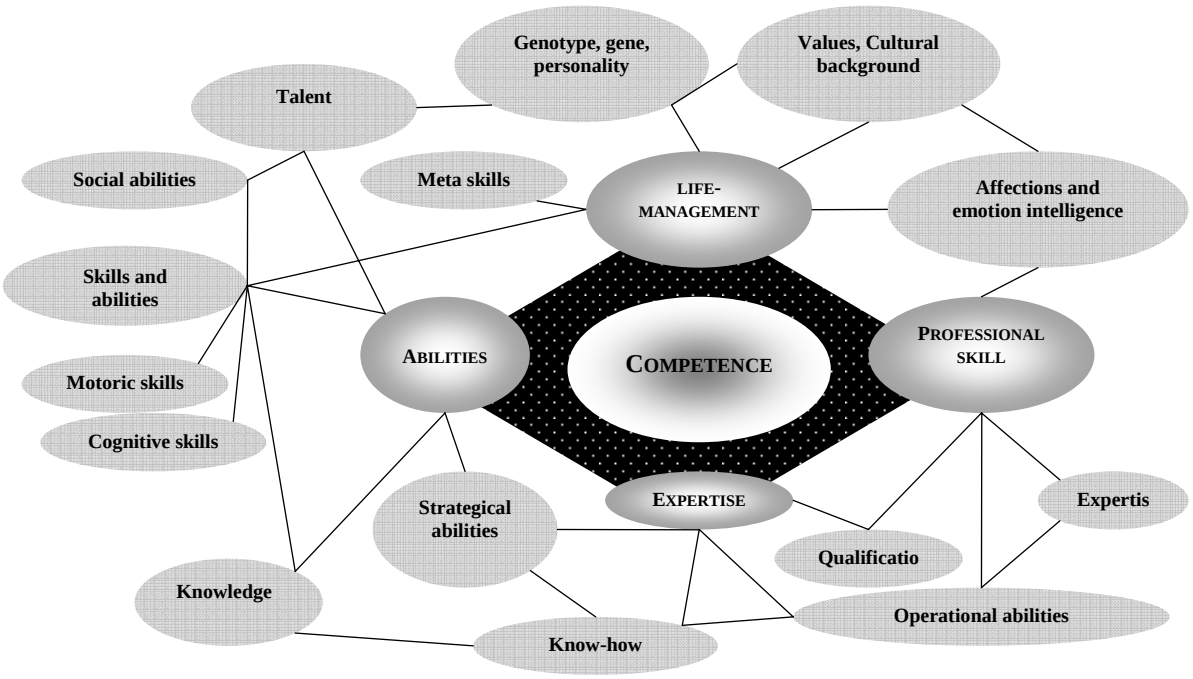


Figure 4.6 The relationship between occupation and competence (Helakorpi 2008a, 4).

Kokko (2000) describes competence development as a continuous process. It is a critical factor for success at the level of individuals, enterprise and society. The process begin from the different needs of groups of actors in an enterprise or society or even from individual workers. The fact is that they all go hand in hand. Individual's competence development might be seen either from an individual or organizational point of view. It can be either the development of occupational or personality competences. (Henttonen 2002, 19.)

4.2.3 Qualifications of Occupational Competence

In the turbulent working environment job requirements and profiles are changing endlessly. The knowledge and skills required in every job, particularly the new ones, is changing every day when new jobs are created. This is a big challenge for all players in the work markets, since also the new qualifications and attributes of each job are to be revised and re-structured every now and then. A lot of flexibility and innovation is needed from all in the creation of new jobs and especially in processing new job profiles and qualifications

for them. For the education planners and organizers as well as for trainers and lecturers this is going to be a big challenge. They need to constantly follow the development of the occupations, occupational competences and qualifications because they are the people who are supposed to educate new professionals and experts for the working society requirements and future job qualifications.

Qualification is defined as the competence that is: a) actually required by the work task; and / or b) implicitly or explicitly prescribed by the employer. Qualifications may or may not be linked directly to required work or its task or even to the occupational competences required by the work. (Ellström 1997, 267.)

Qualification is linked to the work and the occupation. Qualifications are, in a way, work standards or dimensions rather than descriptions of competences. A qualification is not directly linked to the action of work, but it tells what and how a worker is supposed to do and carry out the task or assignment. Qualifications are often given by the organization that indicates and describes the detailed qualifications, needs or standards for work. Generally, qualifications are those work elements or requirements that a worker needs to master according to given requirements by working society, the organization or enterprise. (Nurminen 2007, 85-87.)

Väärälä (1995) uses a classification for production-technological, motivation, assimilation, socio-cultural and innovative qualifications, which in terms of the sawmilling industry is quite relevant. Production-technological qualification means individual's technical professional knowledge, skills and abilities that are the most essential for work performance. In this respect an occupation means a sum of cumulative professional skills. Motivation qualifications are permanent individual characteristics including responsibility and commitment aspects as well as reflection of changes and orientation to new features. Assimilation qualifications mean adaptations to work and agreement of the basic work discipline principles. Socio-cultural qualifications mean the worker's relations to external and internal work organization issues. Innovative qualifications are those dealing with new operations that digress from routine and further develop working processes and procedures. (Väärälä 1995, 42-48).

Taalas (1995) explained that qualification is an attribute that combines workers abilities and work itself to describe the competences required of an individual in the work. Qualification of the labor force is formed through learning in education or training, supported with work experience. Qualification for work takes place through appropriate formal education or training, added with experience of practical work. (Taalas 1995, 7-13.)

Hanhinen (2009) writes that the term "qualification" is oriented from the needs of labor markets. She divides qualification into productivity, normative and innovation dimensions. The first one is seen as a work qualification that analyses qualification from a knowledge and skills point of view and which is linked to technically oriented work performance. The second one refers to person's individual characteristics and the last one to the innovations of a person in terms of work development activities. (Hanhinen 2009, 20-24.) Table 4.2 shows comparisons and differences between occupational competence and work qualification. Qualification is understood as work qualification that has the following characteristics:

1. Qualifications are led from the organizational occupation points of view that are derived from the person's professional skills requirements.
2. Qualifications are understood as the relationship between individual's abilities and work requirements.
3. Qualification is dynamic and changeable.
4. Qualification has a link between the education and the working society.
5. Qualifications can be classified in many different ways.
6. Sometimes qualification is seen differently to qualification requirements.

(Hanhinen 2009, 43-44.)

Occupational competence and work qualification can be understood as a bridge between work, working and the individual's physical and mental abilities as follows:

> "It is important to realize that occupational competence refers to an individual's abilities as compared with the defined work and its qualifications that refers to the standards and definitions required by the work. Work qualifications are requirements of the work set by the working society, organization or enterprise. These must be mastered by the worker(s) in accordance with the given work context and environment (work and organization)." (Hanhinen 2009, 47.)

Table 4.2 Comparison of occupational competence and qualification (Hanhinen 2009, 45).

Characteristic	Occupational competence	Qualification
1. Performance of work	Ability and completion of worker to perform task, assignment or work as a whole	Performance requirement(s) of worker
2. Substance	Describes characteristics of a worker	Description of work contents and sub-contents
3. Dimension of professional skill(s)	Ability to do, whatever is required in occupation, work, tasks or assignments	Skill(s) that are required in occupation, work, task or assignment
4. Structure and classification	Undividable, because competence is integration of sub-competences	Sub-features can be separated and classified
5. Measurability	Level(s) of abilities can be measured	Volumes and meanings of work contents and sub-contents can be measured
6. Education and training point of view	Competence(s) can be developed through education and training	Qualifications give guidance and directions for development of education and training curricula
7. Realization	Occupational competence is going to be realized through fulfillment of required qualification(s) into performance of work	Relationship between worker and working society is going to be materialized into work qualification(s)
8. Competence	Is a feature of a competent worker that is able to perform given task, work or assignment in accordance with the working society requirements	Is worker's competence that have been acknowledged according to set standards or qualifications
9. Context engagement	Is bounded to work context and potential of a worker	Qualification(s) of performance keep changing when context of work change
10. Prerequisite of change	Dynamic	Dynamic

4.3 Competence Development and Learning

The starting point for this research and thesis was the information that the level of knowledge, professional skills and competences of sawmill workers in Kenya was low and the sawmill technology they used were undeveloped. Therefore, in the first instance, learning at work theories was studied. Secondly, the concepts of professional skills, occupational competence and work qualifications as basic elements for occupation were introduced. In order to fully understand the competence development and learning we still need to look at learning theories, adult learners, individual's learning and life-long learning concepts and how these should be considered in competence development of individuals and in planning of vocational adult education and continuing education. We should also look how the technological aspects affect the education and competence development.

People that have appropriate professional education or training as well as practical working experiences are extremely valuable for any enterprise or organization. In today's world competence and learning are critical factors for the success and competitiveness of enterprises. A changing working society needs people that have abilities, willingness and motivation to learn new things and self-develop them continuously.

Learning can be defined formally as the act, process, or experience of gaining knowledge and skills to facilitate us to execute a certain occupation, work or its tasks. Learning helps us to move from novices to experts and allows us to gain new knowledge and abilities to perform work activities more effectively. In the learning process adults spend more time making adjustments to their thinking and behavior than children do, which normally learn by building new concepts and their meanings. Learning requires a lot of energy and even some un-learning. Learning is a lifelong, continuous process. (Conner 2007, 1.)

Learning is understood as a change or an opportunity for a change. In that process experiences are a good foundation to which planning of a new career or a self development programs can be based. Learning is understood as a process, where an individual's behavior changes as a result of an increasing number of new experiences. Individuals can learn in their work and in the real practical and operational situations, if they have been provided with a good learning situation, an adequate learning environment, appropriate trainers and effective training programs. Individuals' learning is important, because of the following reasons:

1. Individual's learning supports the learning of the organization and enterprise, which is more than the sum of the individuals learning.
2. People are able to work more and more efficiently when they can develop themselves and learn something new.
3. Competence development takes place when the existing workers are trained, not when they are changed.
4. Learning opportunities and support for self-development increases working motivation, enjoyment and productivity of individuals.
5. Flexibility and confidence at work advances when workers learn more.
   (Moilanen 2001, 23.)

One challenge in adult continuing education and competence development concerns co-operation between the learners, employers, government institutions and training organizers. All the stakeholder groups need to create and have a common understanding about the importance of adult continuing education, the development of professional skills, the upgrading of occupational growth and competence development as a whole. Government institutions, education organizers, training institutions, enterprises and of course

individuals need to co-operate in this process. Occupational competence for everybody's benefit can only be created through efficient co-operation and partnerships. To succeed in this, it is necessary to establish new partnerships, new enterprise knowledge management systems, new learning environments and new learning at work models. (Issakainen, Kaislasuo, Kiviranta, Lamppu, Malin, Poikela & Silvennoinen 2004, 7-9.)

Learning of professional skills and occupational competences is all about selecting, modifying, interpreting and applying knowledge to practical working situations. Learning is an active and conscious activity through which the learner tries to master working environment, work and tasks more systematically and comprehensively. (International Tropical Timber Organization (ITTO) 2000, 4-5.)

4.3.1 Learning Theories

Learning theories are many, but there is no one theory that works in every learning situation. It is important to understand that learning is a complex issue and is not an automatic result of teaching. Teaching is done by the teacher and learning is done by the student, who is often called a learner. Learning is a demanding mental activity carried out by a learner. (ITTO 2000, 1.) The following paragraphs will briefly describe the most common learning theories that can be use in adult education and competence development.

The behavioral learning approach is based on the change of an individual's behavior that can be evaluated and measured in terms of the individual's reactions to external, reflective surroundings. The approach requires teachers to assist learners in explicit knowledge formulation in a way that the learner is expected to change behavior as a result of the education process. (Ruohotie 2000, 123-125.)

Cognitive learning theory gives attention to individuals' internal mental processes. Observations and interpretations of external subject matters and their stimuli are of particular interest in this learning process. The processes are examined from both developing and development perspectives. (Ruohotie 2000, 123.) "The purpose of learning is to teach the brain to engage in critical thinking and problem solving. This application for training provides hands-on problem-solving activities." (Galbraith & Fouch 2007, 35.)

Humanistic orientation emphasizes an individual's mental potential, humanity and emotions. Learning is more than just cognitive processes. Learning is strongly linked to the individual's motivation, will and responsibility that are prerequisites for effective learning. Self-directed learning models are often linked to this approach. (Ruohotie 2000, 125.)

The social learning approach emphasizes the social environment in which learning takes place. Important in this approach is that learners continuously observe their surrounding environment in terms of interaction and the learning experiences. Mentoring, coaching and model learning models use this theory and approach. (Ruohotie 2000, 125.)

The constructivist learning approach is based on learners' experiences from which he or she will develop and establish a knowledge base for learning new knowledge and skills. Learning in this approach is a process where the learner creates new meanings for learning, both individually and through interaction with others. The distinctive characteristics for this approach are active questioning, independence, self-directed learning, renewal learning, experimental learning and reflective exercises, which all direct learners through self-development processes and individual learning experiences. (Ruohotie 2000, 125.)

Adults' occupational growth and competence development are often based on established interpretations of constructivist and cognitive learning processes and their combinations. A learning process that has been established by constructivist learning theory is a logical but demanding one in the real teaching and learning situation. This is because of the following:

- New knowledge is learnt by using earlier learned knowledge and skills.
- Learning is a result of the learner's own actions to learn.
- Actions are directed by the set objectives, but learning is only achieved in relation to what the learner is actually doing.
- Aspects of learning can be understood and interpreted many different ways.
- Shifting the learning into practice depends how the learner has organized it.
- Social interaction plays an important role in learning process.
- Evaluation of learning should be diversified.
- Curricula should be flexible, where the learner's abilities and changes in knowledge should be considered.

  (Ruohotie 2000, 119-123.)

Learning can be divided into conscious and unconscious learning. In the workplace unconscious learning takes place normally when tacit knowledge is transferred, for instance, to new workers. Unconscious learning is almost the same as behavioral learning, which is also called teacher-centered learning, where the learner is rather passive and the teacher only transfers knowledge, without controlling the learning very much. This is not a recommended approach in adult education. Conscious learning is based on constructivist learning theory. It is the most commonly used approach today. This learning theory is good in adult education because it activates learners and keeps them objective-oriented and ready for any feedback for furthering self-development. (Otala 2008, 65.)

Concluding the discussion of learning theories it can be stated that a combination of cognitive, social and constructivist learning models would be the best for practically oriented education and training such as training in forestry and sawmilling. This is because these fields and their subject areas, especially at the level of workers and operators, are very practically oriented. Therefore, a combination of learning theories based on experiences, self-development and mentoring would be the best to serve learning-by-doing teaching and learning-at-work situations. This approach also would encourage the establishment and use of practical teaching and learning environments that could be arranged in the real working environment – the forest and the sawmills.

When teaching adults, many scholars tried to adopt child-based learning theories up to the late 1950s, but found that they faced serious problems with achieving learning. The reasons for this were mainly the adults' lower potential of the margins to handle the bigger load of learning as well as lower commitment, negative perceptions and critical periods of life. Therefore scientists began to study new theories of adult learning, with Allen Tough being one of the first of these. They found that there are goal-oriented, activity-oriented and learning-oriented types of adult learners who study or self-develop themselves from different personal objectives. Tough studied what and why adults study and how they learn. These studies are the first roots of andragogy. (Knowles 1990, 46-48.)

Knowles wrote in his article on adult leadership in April 1968 about "***andragogy, not pedagogy"***. He argues that pedagogy is for children and andragogy is for adults. What is then andragogy? ***Andragogy*** is defined as the art, skills and science of helping adults learn.

An interesting fact is also that in some experiments even young learners have learned better when the andragogy model has been used in teaching. Knowles concedes that four andragogical key assumptions apply to both children and adults, but the biggest difference comes in experience and pre-established beliefs, which are stronger with adults. This fact should always be kept in mind when planning, establishing and implementing adult education programs. (Knowles 1990, 51-65.)

Table 4.3 Differences between pedagogy and andragogy (Knowles 1990, 55-61).

Assumptions about learners (children) or adults	Pedagogy	Andragogy
1. The need to know	Learners only need to know that they must learn what the teacher teaches.	Adults need to know why they need to learn before undertaking learning.
2. The learner's self-concept	Learners are dependent personalities.	Adults are responsible for their own decisions and for their own lives.
3. The role of learner's experience	Experience is of little resource for learning.	Adults come with a lot of different qualities of experiences, which have several consequences for adult education.
4. Readiness to learn	Learners learn what the teacher tells them.	Adults want to learn those things they need to know and need to be able to do in their real life.
5. Orientation to learning	Learners have a subject-centered orientation to learning.	Adults are life-centered, task-centered or problem-centered.
6. Motivation	Learners are motivated to learn by external motivators – grades and degree.	Adults are motivated by better jobs, promotions, higher salaries, but especially their motivators are internal factors like better job satisfaction and quality of life.

4.3.2 Individual and Adult Learning

Jarvis (1995) begins his book of adult and continuing education by writing that,

> "Human learning is a lifelong process – human beings have probably always the capacity to learn throughout their lives – lifelong learning is not the same as lifelong education – learning and education are fundamentally different concepts. Society is a complex social system in a state of continuous change and that change is the norm rather than the exception." (Jarvis 1995, 1.)

Every time when an individual learns something, there is a process of learning, which is called a process of socialization. Education is used for many purposes, but the most

important purpose is to prepare individuals to respond to the social changes occurring (Jarvis 1995, 3). One of the fastest social and cultural changes today is obviously technological development and the knowledge related to this. During the last ten years for instance ICT has developed faster than anything else. It is even said that this period is seeing the next biggest revolution since the invention of electricity, the telephone or the so called industrial revolution. This affects all of us in one way or another. Technological change and development also challenges individuals to educate themselves more. “Hence the more people’s knowledge becomes outdated the more new knowledge they have to learn if they are to remain in harmony with their culture” (Jarvis 1995, 4). All these changes are pushing adults and all of us to learn more every day. Whether it is through lifelong education or lifelong learning does not make a big difference, but the fact is that in order to cope with constant technological changes and development, individuals, regardless of their age, must educate and self-develop themselves for their whole lifespan.

Every adult is a learner with his or her own characteristics. Through relationships and communication between individuals and their cultures there are always learning experiences going on. The best adults learn in problem-solving learning situations. Adult learning in most circumstances is based upon an experimental approach that is linked into the prevailing socio-cultural environment. Adults develop themselves throughout their lifespan. On many occasions and in many situations adults go through self-directed learning even without attending educational institutions. (Jarvis 1995, 82.)

Many of the adult’s learning situations or occasions are self-directed where a teacher or educational institutions are not even involved. This is the situation in real life, when individuals learn every day by observing and doing things without any educational connections. Of course, the learner not the teacher is the essential part of the learning process, which can take place autonomously without a teacher.

Normally, and particularly in adult education, learning requires that a learner can connect the learning content with some previously learned matters or experiences. An individual’s learning is a many-sided process and can take place on many levels simultaneously. For instance, during the internalization process the learner connects theoretical aspects to the practical implementation of work and during externalization of a certain model the learner

connects up the learning for concrete problem solving. “The basic nature of the human being is to seek positive and pleasing experiences and to avoid experiences which cause grief. This means that the teacher should use more methods and procedures that produce satisfying experiences than those which cause displeasure.” (ITTO 2000, 5-6.)

What are the characteristics of adult learners and how do they differ from younger learners? One of the biggest differences is that adult learners come for training or education with more and richer experiences from working society, workplaces and work. They may have several years of professional experience from several different fields and occupations. In addition, adult learners have longer life experience, which guides their decision making in training. Because of the wider scope of life and work experiences adult learners look at their training, its contents and objectives more critically. Because of their longer experiences they are able to link theoretical and practical training more effectively to real work situations. Adult learners know exactly what they need to know and why they want to learn new things. This improves their motivation for studies and makes the setting of objectives more realistic and target-oriented. Prioritization of training programs is easier for adults because they have clearly set learning objectives and a clear vision of the future. (Vaherva & Ekola 1986, 20.)

We already know that adult learners are motivated, active and objectively oriented, but what factors affect their learning? We should think about the cause-effect relationships in an adult’s learning process. All of us have our own style of learning, which depends on our personal abilities, experiences, motivation, personality, talents and physical characteristics. The factors that mostly affect a person’s learning are the following:

1) The individual’s situation in life; family, working community, social environment, cultural obligations and living conditions.
2) The individual’s earlier educational and learning experiences and heredity.
3) Supporting activities linked to training and learning that make learning more successful and fruitful like mentoring, guidance and tutoring.
   (Vaherva & Ekola 1986, 124-126.)

Adults’ learning is based on constructivist learning theory, where the key elements are motivation, social-learning and the learning environment. In today’s society there is plenty

of knowledge available and anyone can learn to ask for it, but if a person does not have the motivation and willingness to learn, learning fails. Constructivist learning is based on experiences, as Kolb and Poikela introduced it. For adults education the contextual learning model is the best and the most recommended. Work is the best apprenticeship and teacher, because human being learns 10% by reading, 15% by hearing and 75% from experiences. Research has shown that at least half (50%) of learning occurs by doing. (Otala 2008, 66-71.)

The most important aspects in adult and individual learning are self-direction, self-regulation and learning through experiences in lifelong learning. Self-direction in this connection means that an individual takes the responsibility for the planning of training objectives and procedures and for directing own self-development and decision-making in education. Secondly, self-regulation means that the human being has the ability to consciously control own activities, operations and procedures so that set self-development and training objectives can be reached. Personal needs, values, motives, intentions and satisfactions affect an individual's self-regulation, how self-development objectives will be set and what the learner does in order to reach the objectives. (Ruohotie 1995, 1-49.)

The aspect of lifelong learning or learning through experiences is an interesting aspect in adult learning. It is a model that keeps an individual's learning and development in continuous progress. The following are the typical features of adult learners:

1. Adults are autonomous and self-directed and therefore they should act as training facilitators and experience providers in the learning process.
2. Adults have valuable life and work experiences that should be used as a basis for the learning process.
3. Adults are goal-oriented and education should be established with regard to these goals.
4. Adults are relevancy-oriented and objectives should be set so that they are able to apply learning to real work situations.
5. Adults are practically oriented and education and training should be established according to problem-solving approaches to give answers to what and why questions.

   (Galbraith & Fouch 2007, 36.)

Adult learners learn through activities so it is good to give them initiatives, to allow choices and to allow them to act and interact during the learning process. Normally, adults come to training with their own materials and experiences. It is good to facilitate them to use their existing knowledge and skills though sharing of experiences and teaching each other. Adults need to be given a chance to bring in their positive experiences for the benefit of others. This indeed creates a positive learning atmosphere and environment as well as a strong foundation for learning. (Galbraith & Fouch 2007, 37.) This type of approaches could easily be used also in training of sawmill workers in Kenya, where practically oriented training occasions could be arranged either at the sawmills or at the FITC.

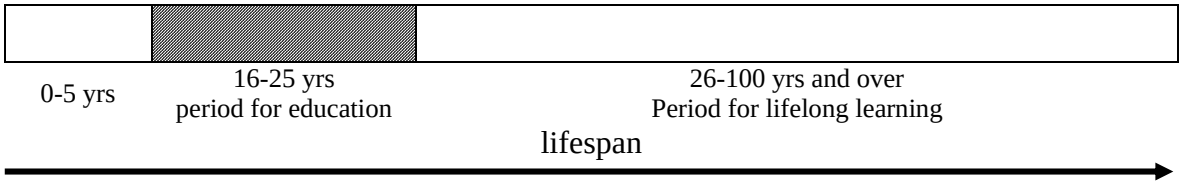
4.3.3 Lifelong Learning

Change in today's working society challenges individuals, organizations and their occupational competence development. The operational results of an enterprise are not only monitored by the owners and enterprise profitability but also by the customers and employees of the enterprise. Therefore, everybody's competence counts towards the enterprise's viability. This requires continuous development. (Hätönen 1998, 9.)

Lifelong learning in all respects is a vital process in ensuring sustainable and effective individual learning, enterprise development, productivity improvement and the economic growth of the enterprise as a whole. In order to succeed in this everybody in the enterprise must first of all understand the concept of lifelong learning and secondly must participate in learning at work and self-development.

In lifelong learning there are several conditions and features that need to be considered. For instance, we need to follow global, social and cultural changes, technological development and the acceleration of knowledge creation in respect to this. Individuals, enterprises and working societies are close to each other and therefore need to be considered in lifelong learning and for further development of everybody in harmony. Human begins are lifelong learners. In order to understand themselves, their society and their culture better they need to carry on with lifelong learning throughout their lifespan. Jarvis (1995) has built up his lifelong learning theory on the front-end model, which means that education takes place only during the formative years when children go through their

initial education, but as soon as they mature into adulthood their education will cease (Jarvis 1995, 16). Figure 4.7 shows the front-end model and period for lifelong learning.



Source: Boyle (1982, 8).

Figure 4.7 The front-end model of education (Jarvis 1995, 16).

Systems theory, which studies complex systems in society and organizations and supports the development of technical professions across the traditional academic boundaries provides good basis for the establishment and administration of lifelong learning for individuals, organizations, enterprises, communities and nations. Knowles' model for a lifelong learning resources system is based on the following main assumptions:

1. Learning in a fast changing world must be a lifelong process.
2. Education and training create competences for different life situations.
3. Because of individual personalities, abilities, experiences and learning styles, lifelong learning programs need to be individualized, particularly for adults.
4. The primary task of learning system is to identify and allocate the resources available and link them to learners, organizations and institutions by establishing and organizing lifelong learning programs.
5. Learners, especially adults, who have traditionally participated teacher-centered education, need to be assisted to become self-directed learners.
6. Any individual learning needs to be interlinked with other learners.
7. Lifelong learning needs to be guided by process structure, meaning a learning plan rather than a course outline.

   (Knowles 1990, 171-172.)

4.3.4 Technology Development Versus Competence Development

Technological change is one of the biggest reasons that knowledge, skills and occupational competences become out of date. In the late nineteen-nineties Bill Gates of Microsoft Corporation stated that within the next ten years working society is going to change more

than it has changed during the last fifty years. This was a significant observation, which should be considered when improving and developing both the technologies and peoples' competences. Competence can be seen as a bridge between the technology, markets, production and competitiveness and viability of an enterprise. This will also be the situation and the fact in development of the Kenyan sawmilling industry and the sawmills.

Technological changes set new competence requirements for all - individuals and enterprises. It is obvious that competences must be developed simultaneously with technological development, which indeed is a big challenge for enterprises and education organizers. (Hätönen 1998, 8.) This will be also the big challenge in development of the Kenyan sawmilling industry.

Occupational growth and competence development is all about the improvement and development of technologies, knowledge, professional skills and real experiences of individuals, teams and organizations. We should remember that these are closely related to the development of working tools, equipment and working methods as well as the technological development of enterprise. Competence development in a technological sense is a prerequisite for sawmill enterprises to keep up with business competitiveness.

Technology transfer to developing countries is a complex issue. It requires special professional skills and experiences from both the local counterparts and the experts working with them. This is because all people involved need to know the local conditions and prevailing enterprise circumstances. In effective and sustainable technology transfer there is always a need for competent personnel, know-how and skills, physical objects and appropriate technology. Technology itself is a combination of physical equipment and the techniques and know-how to assemble, operate and maintain it. (Karani 2001, 230.)

Institutional, technological and human resource abilities and competences are important factors in technological development and human resource capacity building in Africa. Some of the constraints and obstacles in technological transfer to Africa are the following:

1. Manufacturers and suppliers of appropriate technologies, tools and equipment are not locally available.

2. Competent personnel to assemble, operate and maintain these new and appropriate technologies are not available without the establishment of comprehensive capacity building and competence development programs.
3. Strict and out-dated government and customs regulations as well as unavailability of up-to-date standards in technological transfer are complicating the transfer of new and more appropriate technologies.
4. Research and development facilities are inadequate and personnel are not yet competent enough to deploy technological development and transfer.
   (Karini 2001, 231.)

Drejer and Riis (1999) noticed in their research on "competence development and technology" that technology development plays an important role in competence development and organizational learning. "Technology is often the most visible part of a competence, since it represents the tools that human beings use to do activities." Therefore, workers' occupational competence development plays an important role in technological development and the introduction of new technologies, for instance in the introduction of new sawmill technologies to Kenya. (Drejer & Riis 1999, 632-636.) Technological development, technology transfer and competence development go hand in hand, so if there is technological development there is also definitely a need for the development of know-how, professional skills, occupational competences and individual and enterprise competences as a whole.

5 COMPETENCE DEVELOPMENT MODELS

Systematic and efficient human resource development is the key to a enterprise's success as it guarantees that the right people are in the right place at the right time. Through efficient human resources development the enterprise can make sure that its employees have the right knowledge, appropriate professional skills and adequate occupational competences to carry out their required work. To enable this, the development objectives must be linked to the values and strategies of the enterprise. In this process there are issues like attitudes towards capacity development, planning processes, training needs assessment, participation and leadership as well as sources of training, and their monitoring and evaluation that need to be considered in advance. (Hätönen 1998, 7-23.)

"Efficient and competitive private sector enterprises do not develop solely because of their own internal capabilities." These enterprises are developed by innovative entrepreneurs, professionally skilled managers and a motivated, dedicated and well-trained work force that is supported with efficient management, administrative and operational procedures. "Generally, a private sector needs an overall "enabling environment" which allows private enterprises to operate efficiently and specific institutions and policies that promote private sector development." (Kennedy & Hobohm 1999, 5-6.) To do this efficiently there must be certain development models and approaches that can be used by both facilitating organizations, institutions and participating enterprises.

We already discussed that technological development is a factor in enterprise development that must be considered on a continuous and sustainable basis to become visible and to maintain an enterprise's competitiveness. An enterprise's technological development is an impulse and starting factor for a learning organization that can be put into practice by a competent labor force carrying out individual lifelong learning. Lifelong learning can be implemented and materialized through a certain model. In chapter four it was argued that everything in this process begins from an individual's learning, particularly from the competence development that must be linked to enterprise development on a lifelong learning basis. In this environment, by using the most appropriate and efficient learning theories and models, the required individual professional skills and individuals' occupational competences can be developed so that the whole enterprise will benefit.

In the following paragraphs a comprehensive cycle of the "Enterprise Competence Management Model" (ECMM) will be introduced and explained as an option for continuous and sustainable sawmill enterprise development and individuals' competence development in Kenya. The ECMM was developed and introduced in the project that was directed to SMEs in Finland in 2006. The project where the model was built and tested was a training and development program that strengthened the abilities of SMEs to analyze, maintain and develop professional skills and occupational competences. (Nurminen 2007, 27-34.) This model was already partly tested in Kenya when the empirical part of this research was carried out in September–October 2008. The part that was tested in Kenya included stages one, two, three and four of cycle I. Cycle I is the cycle called the Establishment of Competence Development Requirements, which includes seven stages, as it will be explained in section 5.2. To support establishment and implementation of the ECMM Poikela's Contextual Learning Model was briefly introduced in the section 4.1.2 and it will be more explained under the section 5.1. The proposed two models can be used for analysis and development of both individual and organizational competences in the sawmill industry and in the individual sawmills in Kenya, now and in the future. The general concept of individual and enterprise lifelong competence development and learning at work principles are illustrated in Figure 5.1. The same figure also shows the factors affecting to these processes. The explanation of Figure 5.1 is given in the next page.

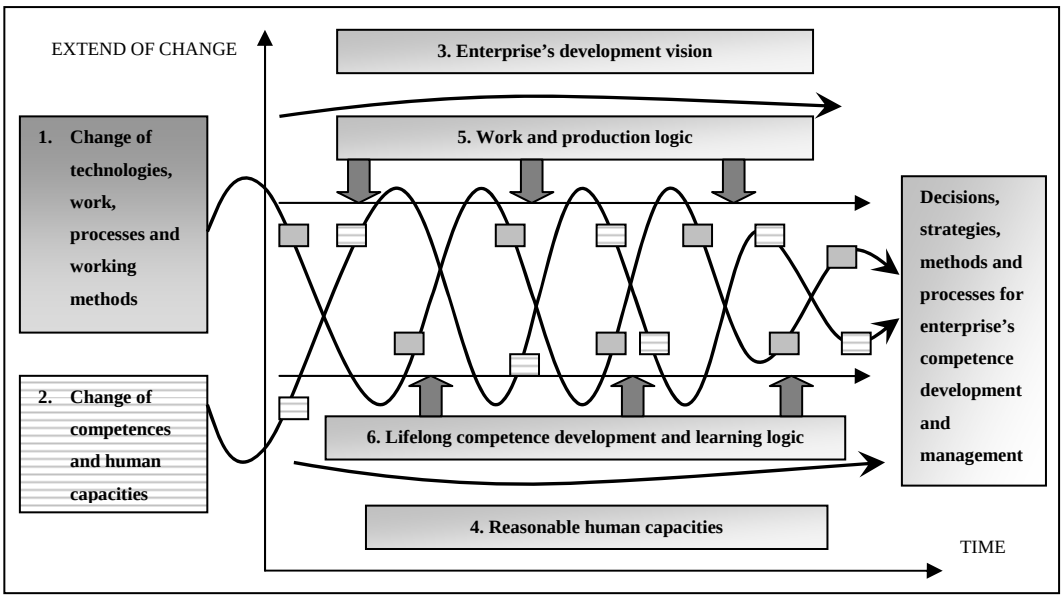


Figure 5.1Work and technology development versus lifelong competence development and learning logic (Nurminen 2007, 39).

Individual and enterprise lifelong competence development and learning has the following characteristics: (numbers in the brackets correspond to numbers in the Figure 5.1)

1. When the level of technology and work requirements (1) are changing, in other words they are decreasing or getting old, the competences and human capacities (2) are also changing, in other words, they are improving and getting better in comparison to decreasing work and technologies. At a certain point they have a balance, but most of the time they are either below or above each other, requiring different types of development activities.
2. The development vision (3) of an enterprise goes hand-in-hand with its human capacity (4) in terms of time and degree. These are always - while changing – affecting work and production logics and their development (5) as well as lifelong competence development and learning (6).
3. Due to the changes taking place in work, technology, competences and human capacities as well as a need for lifelong competence development and learning, the organization or enterprise must establish and implement appropriate competence development models, processes and schedules in order to meet the set business objectives and to maintain enterprise viability and competitiveness. The ECMM is introduced in section 5.2.

The four attributes and their features for enterprise's continuous competence management and development are shown in Figure 5.2.

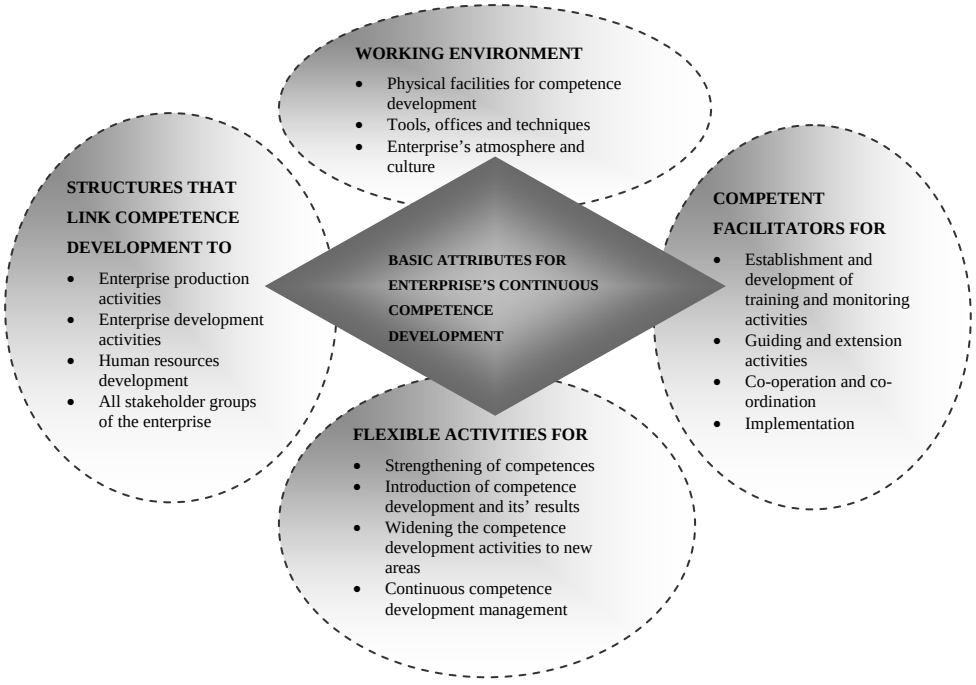


Figure 5.2 Attributes for enterprise's competence management (Nurminen 2007, 77).

5.1 The Contextual Learning Model

Learning at work process is a theoretical structure that has been developed from theories and models of contextual learning and creation of knowledge. Several research results have shown that the usefulness of this model is based on its ability to reflect, contextualize and use work experiences to create, develop and improve new experiences, occupational competences and learning at work as a whole. The results of this process are valuable for the management of enterprise human capacities and learning at work. (Poikela 2005, 34.)

Poikela (2005) explained that reflective observation is only one stage of the contextual learning process, but reflection is a feature of the all four stages of the learning process. In this respect Poikela's model differs from Kolb's model, in which reflection is only a feature of one stage of the contextual learning process. Reflection is an important feature that keeps learning progressing in between experiencing, thinking and doing. Poikela's model is also illustrated in the Figure 4.1, where Kolb's model for contextual learning was explained. Poikela has listed the following four stages for the contextual learning process:

1. Concrete experience(s) occurs in work or the working environment, while working. (step 1) Learning begins here by realizing a concrete experience.
2. Reflection on action is a reflective observation of concrete experience/s after real work actions. (2) Here learning continues by reflecting and considering the gained experiences
3. Reflection for action is an abstract preparation phase, where construction of new actions and experiences takes place and consequently where the development of new reflection begins. (3) Here understanding of the phenomenon happens and the new experiences will occur to create learning.
4. Reflection in action is a stage where conceptualizing of new concrete experiences takes place. (4) Here new actions and new concrete experiences are generated again.

(Poikela 2005, 24-26.)

The contextual learning model is a model, in which learning occurs through experiences by reflection. Learning can happen in the level of individuals, teams, groups, organizations and enterprises.

From Figure 4.1 we can see that the second and fourth stages are the main elements of contextual learning, where the most reflections take place. New concrete experiences will appear during the first stage of the learning at work process. These will lead to new learning through the reflection on action for experiences. Reflection in that learning process is understood as an individual's observations and consideration of gained experiences. The purpose of reflection is to keep concrete experiences alive, and within the process of conceptualization these reflections will produce new actions, hopefully new experiences and consequently new reflections. Continuous reflection keeps up the learning process in between experiencing, doing, conceptualizing and processing of new experiences and reflections. Poikela highlights that concrete experiences are the basis for both new learning experiences and the real final results of learning.

This contextual learning model could be introduced, tested and used in the development of the Kenyan sawmilling industry, sawmill enterprises and their workers. If learning experiences and learning as a whole are effectively monitored many occupational competence development areas and qualification requirements in production operations and work can be determined. With this information, competence development areas both at individuals' and sawmills' levels could be identified and further developed. The model can be used for both the evaluation and monitoring of existing competences and the improvement and development of new ones. However, in order to do this effectively it requires a comprehensive system or model that enables us to analyze, plan, establish and manage both the individuals' and enterprises' competences at the sawmills' level. The Enterprise Competence Management Model (ECMM), which is explained in section 5.2, is a good tool in comprehensive enterprise's competence development process.

5.2 The Enterprise Competence Management Model

Nurminen (2007) developed an ECMM that is meant for enterprises and organizations that are interested and willing to develop their competences both at individuals' and enterprise level. The introduction of the model consists of all the processes, persons responsible for implementation and tools, methods and resources that are required in efficient enterprise competence development and management. The model is set up into a "process model" in which one cycle is divided into two main components that are:

I. **Establishment of competence development requirements**

II. **Competence development implementation.**

(Nurminen 2007, 26.)

In progressive and long-term competence development the process consists of many cycles following each other. In this kind of progressive competence development it is important that the process and achieved results and experiences of the earlier cycle are monitored, and that the achieved experiences and results are used for planning and implementation of the next cycle. Nurminen concluded (2007) that the model has given many benefits for the enterprises and their personnel first of all during the establishment stage on knowledge and methodological aspects and secondly during the implementation stages on real competence development at the enterprise level (Nurminen 2007, 27).

The fundamental factors in the model are ***competence***, ***professional skill*** and ***competence management*** at the individual and enterprise levels. ***Competence*** is the readiness to act and carry out certain work. ***Professional skill*** is a composition of an individual's knowledge and skills that have been gained through appropriate education, long-term work experiences and continuous self-development. ***Competence management*** is all those activities and operations that an enterprise or organization uses for the creation of competences and professional skills of the personnel. Competence management is a wider concept than only competence development because it consists of many other elements rather than only the development of competences such as assessment, analysis and monitoring of occupational competences.

In this thesis Nurminen's model has been followed, but with consideration for the special features and conditions of Kenyan sawmills and forestry and sawmilling education in Kenya. The proposed model can be used for both development and management of individual and enterprise competences. Explanations of the twelve steps of the two main components of a one complete cycle of the ECMM are given in the Figure 5.3. The sub-components the ECMM can be methodologically divided into analytical, information collective and development methods. Figure 5.3 illustrates on the left side a single ECMM and demonstrates on the right side a structure where the ECMM has been implemented progressively in three consequent cycles.

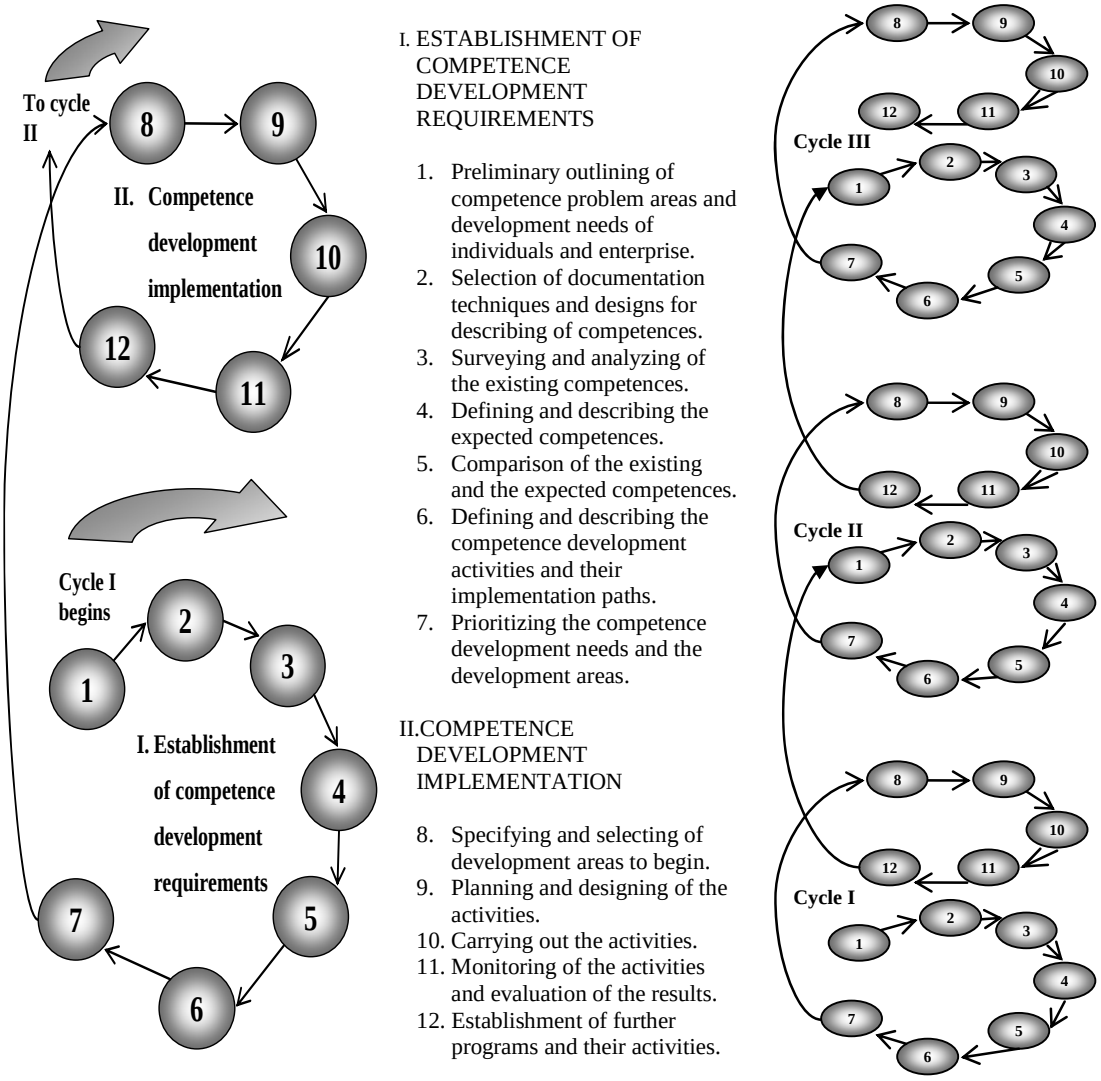


Figure 5.3 Structures of a single and a progressive ECMM (Nurminen 2007, 31-33).

When planning the implementation of the ECMM there is always a question of where to find good, appropriate and efficient tools and methods for the implementation. Paananen introduced in 2007 a bench learning and couching model that is a useful and good tool in carrying out enterprise's and individuals' competence development. This model is based on bench learning approach that can be described as a combination of business development, competence development and a learning organization approach. The bench learning model aims at the real learning organization where participating enterprises and their organizations learn from each other and can therefore develop their own operations and competences mutually to become more efficient, competitive and economically viable.

6 RESEARCH METHODOLOGY AND APPROACH

The main objective of this research was to study and define competences of sawmills' and their workers in Kenya and to compare them in relation to sawmilling technologies. Through this work factors affecting sawmill workers' competences were examined and their training needs were collected, analyzed and reported. The work was divided into literature review, field survey work in Kenya and preparation of the research report.

When establishing the research of people's behavior there must be considerations of the type of research approaches. These approaches depend very much about a) the context and environment of the survey, b) the social and cultural structures of the target groups, c) social interactions between the respondents and researchers, d) individuals' interpretations and e) individuals' free will. (Morrison, Halley, Sheehan & Taylor 2002, 17).

The cultural aspects, working environment, society, workers and people in Kenya are different when comparing the same aspects in other countries and continents. These were considered and therefore qualitative and quantitative research methods were selected and combined. It was expected that selected approach provided the best opportunities for considering human aspects and various environments. The approach provided excellent flexibility for the researcher to consider the research questions and the demanding research settings in the respect to the particular African conditions, society and environment.

The main selection criteria for the research methodology and approaches were as follows:

- Interviews and filling out the questionnaires was more effective through one-to-one interaction and direct communication with the research participants.
- The experiences and personal opinions of the interviewees were easier to absorb through oral conversations.
- The sawmill managers and owners were chosen because it was known that they are the most experienced workers and they have information available.
- Another fact that supported in the selection of the method and approach was the fact that Internet and ICT in Kenya are not yet that efficient and reliable.

6.1 Research Strategy and Concept of the Methodology

Qualitative and quantitative researches are two distinctly separate research strategies that can be oriented as a single research effort (Bryman & Bell 2007, 28). “Methodology refers to the choices we make about cases to study, methods of data gathering, forms of data analysis and so on in planning and executing a research study” (Silverman 2005, 379).

Small enterprise research, like this one of the sawmills in Kenya, always involves studies of human competences, actions and behavior, which is essentially concerned with the nature of reality in the social world, working society and local environment as a whole (Shaw 1999, 59-61.) In order to succeed in this research, the researcher needed to adopt a strategy and method that allowed him to get closer to the research participants. The nature of the SMS sawmill enterprises and their personnel were a special characteristic of this research. Therefore, the qualitative research approach, supported by a quantitative method, was an appropriate research combination for this type of field survey and questionnaire research. This approach allowed more comprehensive personal observations and monitoring of the real production situations and the real prevailing production constraints. A major challenge in the selection of the research methodology and approach was the selection of the tools to measure, observe and analyze abstract features such as human competences, their professional skills, workers’ knowledge and abilities.

An important feature of the field survey method and direct questionnaire approach, combined with the pre-structured interviews was that with well gathered data and its’ analyses a phenomenon can be more effectively described, compared and explained than it can be done when only mailed questionnaires are used. Quantitative and qualitative methods are difficult to separate because they usually support each other rather than compete with each other. (Hirsjärvi, Remes & Sajavaara 1997, 125-127.)

An inductive approach was used in this research to analyze the qualitative research materials. The inductive approach was based on the study of particular practical cases rather than what was derived just from theory. In this process, the theory was initially used as an instrument to formulate the thematically oriented survey questionnaire on sawmill’s competence development aspects to support data collection of the practical information

through in-depth interviews with the participants and through the field survey work. The inductive approach was also an instrument that guided the research process towards the achievement of the research results, the final analyses and conclusions and eventually the establishment of models and recommendations that facilitate solving the research problem.

The triangulation method - meaning that more than just one survey method - was used in implementation of this research first to achieve truthful results, secondly to carry out more rational analysis and thirdly to develop appropriate and effective solutions to improve and develop the prevailing situation through the proposed models. The triangulation method provided a solid basis for this research as it facilitated effective use of the three different field survey methods, which were: 1) questionnaire; 2) personal interviews; and 3) observational qualitative data collection and with their analyses. The triangulation method provided also an excellent opportunity for a composition and comparison of researcher's own personal experiences with the new up-to-date information, which facilitated further establishment of the research results, conclusions and recommendations.

6.2 Research Methodology

The research was practically oriented, but theoretically established with strong link to practical experiences and field survey. At the beginning of the research only the most important theoretical aspects and definitions were studied. These supported the preparation of the field survey and the establishment of the structured questionnaire to be used for semi-structured interviews.

The qualitative strategy was a basis for participants' and stakeholder groups' in-depth interviews and observations. The qualitative strategy was used to compose personal observations and in-depth screening of the sawmills' working environment and society whole. The quantitative research strategy was used for analysis of the semi-structured questionnaires.

6.2.1 Collection of Research Material

The field survey and interviews in Kenya were executed on the 23rd September to the 31st October, 2008. Names of the visited sample sawmills are shown in Appendix 3. During the field survey and interviews in Kenya the researcher was assisted by the technical assistance personnel of the KFS. The Head of Sawmilling of the KFS provided valuable and professional assistance throughout the field survey period.

The literature reviews in this research was divided into three parts. Firstly the preliminary review covered the educational and learning at work subjects. This information was used as the basis for the formation of the structured thematic survey questionnaire and the semi-structured interview. The thematic grouping of the subject matters established during that period was the basis for the research project and its reporting. The preliminary review provided also a good understanding of the phenomenon, which enabled planning of the field survey activities in Kenya. It also provided guidance for the empirical data collection. Secondly during the field survey work a review about the forestry and sawmilling aspects in Kenya was done. Thirdly the comprehensive theoretical literature review on the educational and competence development aspects was executed after the field survey.

When the research location and the prevailing condition in Kenya were considered, the decision was made that the researcher himself would lead and carry out the data collection and interviews. A factor that also supported this decision was the selected and combined research strategy, where the data collection, personal interviews and observations of the sawmill conditions were supposed to be carried out simultaneously within one visit.

In the preliminary discussion with the Niras Finland Ltd it was agreed that only registered SMS sawmills will be selected as the target group of the research. This pre-assumption was changed in Kenya when the discussions were held with the representatives of the KFS. The KFS advised to include all the registered Kenyan sawmills in the research. The first reason was that the KFS had recently carried out a prequalification process for the sawmills and therefore they wanted to make a comparison between these two researches. Another reason was that during the prequalification process the sawmills' and their workers' competences and training needs were not comprehensively identified and analyzed.

The field survey activities were planned so that the research materials and data were collected directly from the participants in their sawmilling environments and participants' work premises, primarily during the operating hours of the sawmill. The data was collected through in-depth and pre-structured interviews with the sawmill owners and managers of the 22 sample sawmills selected. Simultaneously with the interviews the questionnaire forms of the data were collected and recorded. This was made into the structured and thematically drawn questionnaire that is shown in Appendix 1.

6.2.2 Research Questionnaire and Interviews

To identify and find out different needs of the target groups there are several options, methods and approaches, which depend on whether we carry out quantitative or qualitative research. The most common methods are interviews and questionnaires that change depending about the research context, environment and prevailing survey circumstances.

The questionnaire was used for data collection simultaneously with a pre-structured interview, in which the respondents answered the questions orally. The interviews were face-to-face situations between the interviewer and one to three sawmill representatives. In all cases the sawmill owner or manager was one of the persons interviewed. Most of the interviews were recorded. The structured questionnaire was used as an outline for the interviews and discussions. The interviews lasted between one to two hours.

These methods were chosen because the interviewing situation was a unique and the only possible occasion, because of the interviewing time during the sawmill's operational hours, logistical reasons and long distances between the research areas and sawmills. Other concerns that supported in the selection of the methods and approaches were as follows:

1. The use of two methods facilitated more accurate data and survey results.
2. Personal visits provided personal interactions with the sawmill personnel.
3. Multi-methods and constant guidance during the interviews reduced errors.
4. Progress of the interviews and the field survey was improved and ensured.
5. Understanding of the questions was guaranteed due to further clarifications.
6. The approach gave an opportunity to observe and monitor the sawmills, technologies, workers competences and problems occurring in the operations.

The questionnaire itself was structured thematically in consideration with the research problem. Setting of the questions were made so that both individual and enterprise perspectives were questioned. The same thematical sequence has been used also to elaborate and report the research results. The questionnaire was tested, by the Chief Technical Adviser of the Miti Mingi Maisha Bora (MMMB) project and the Head of Sawmilling of the KFS, and it was modified in respect to the given feedback.

The questionnaire was divided into five main thematic components consisting of various questions and variables in each of them. The main thematic components were:

1. *Background information of the sawmills and the survey respondents* gathered information about the sawmills, nature of the business and the respondents.
2. *Sawmill technologies and technological development* comprised information about the production technologies, maintenance and development requirements.
3. *Sawmill production and its limitations* contained information about the production capacities, volumes, recovery issues and value adding.
4. *Education and training* dealt with aspects of employment, workers' education, training and co-operation with training and research institutions.
5. *Competences and competence development initiatives* included information about workers and sawmill enterprises competence aspects.

The questions in the questionnaire were set up either using the Likert scale, multiple choice or open type questions. The multiple choice questions had ready made alternatives to be chosen by the interviewee. The open questions were set for the purpose of further clarification of the multiple choice questions. The Likert scale questions had a five-class classification where one corresponded to complete disagreement, two to disagreement, three to uncertainty, four to agreement and five to full agreement.

In this research 22 sawmills were selected, but the saturation point was already found when 17 sawmills were interviewed. Reaching of the saturation point normally means that there is no need to collect additional data. This approach was not exactly followed because the research included both quantitative and qualitative approaches and therefore all the selected 22 sawmills were visited and interviewed.

In addition to these 22 sawmills visited there were eight other places visited, where only oral interviews were arranged. These places included the KFC in Londiani, the FITC in Nakuru, the Kenya Forestry Research Institute (KEFRI) in Nairobi, the TMA in Njoro, the MMMB project in Nairobi, the Economic Housing Group in Nairobi and Naivasha, Comply Industries Ltd in Nakuru and the James Finlay (Kenya) Ltd tea farm in Kericho.

6.2.3 Sampling

In educational and social research it is seldom possible to include the whole population in the research. This is because the absolute population is usually too large to create and have an adequate sample and number of selected units. (Hirsjärvi et al. 2005, 169.) When carrying out educational and social research, like this one in Kenya, it was important to consider the limiting factors such as local conditions, logistics, infrastructure, ICT and the timeframe. This was also important in order to define a correct, authentic and suitable sampling method and a precise sampling frame in accordance with the existing population.

Sampling and selecting a sample is a statistical procedure for finding cases to study. Sampling must be so large that it allows a researcher to feel confident about the sample representativeness and it allows the researcher to make inferences of the sampling frame and the entire population. (Silverman 2005, 180.)

One selection criteria of the sample was the size of sawmills, which was supposed to represent the density of the sawmills within that size cluster in Kenya today. Therefore, in order to do this the definitions and criteria of sawmill sizing and classification in Kenya was studied. Mbaabu et al. (2008) have explained the sawmill sizing and classification criteria in their prequalification inspection report of the Kenyan sawmills. They indicated that Kenyan sawmills have been categorized into three different size categories as follows:

1. A large scale sawmill is a sawmill that has over $20m^3$ of daily production.
2. A medium scale sawmill has a daily production of between 10-20 m^3 per day.
3. A small scale sawmill is the sawmill with less than $10m^3$ of daily production. (Mbaabu et al. 2008, 1.)

Mbaabu et al. (2008) have not explained in their report whether the daily production capacity was the sawmill's input or output capacity in m^3/day. An assumption was made that it was a daily output capacity of sawn timber produced in m^3/day.

Bryman and Bell (2007) have pointed out that stratified sampling "ensures that the resulting sample will be distributed in the same way as the population in terms of the stratifying criterion". Stratified sampling is a good approach and method when there is a good statistical database available. It gives flexibility to the researcher to make a decision on identification and allocation of the units for the strata. It also gives possibilities to use and make more than just one stratifying criterion. (Bryman & Bell 2007, 187.) In this respect, and in consideration of the sawmilling industry in Kenya and the location of the forest plantations and the sawmills, it was decided that a ***stratified random sampling*** would be used in this research, leading to a research population that was stratified by the criteria that was set in advance. This meant that selected provinces and from these the selected districts were participating in the research. A selection of a simple random sample from each of the resulting strata was made. The ***research sampling frame*** criteria and selections of the sample sawmills are explained in the following paragraphs.

A probability sample approach with a selection of simple random samples was used for selecting the sample units (sawmills). This decision was made in order to avoid and minimize the sampling errors, because of the local infrastructure features, such as logistics and ICT constraints, that were influencing the research and selection of the sampling areas.

The most important selection criterion of sawmills was the daily production capacity. This criterion was purposely chosen, because it was known that the medium and large scale sawmills have comparatively more workers than the small ones and their operations described more relevantly the average sawmilling enterprise in Kenya today. Another reason for giving extra weight to medium and large scale sawmills was the fact that these were more operational than the small ones. One selection criteria was also that more than two sawmills must be represented in each sawmill size category.

The sawmill sizing and classification of Mbaabu et al. 2008 was used for creation of the stratified sampling of this research. A reason for choosing this was that the KFS had just

carried out and completed nationwide sawmills prequalification inspections and they had the ready made database with the sawmill sizes and locations available. The population chosen for this research was therefore 276 registered sawmills, that were identified by the KFS in their prequalification inspection in 2008. The farmers using simple mobile circular saw benches, the chain saw operators and the pit sawyers were not included.

When selecting the sampling frame and the sample the local conditions had a significant meaning in the decision making. The important selection criterion was the location of the industrial forest plantations and the sawmills. Another aspect in the unit selection was to look at the sawmill coverage in terms of their size, location and distribution. This was found important as to have an even distribution of the units within the sampling frame and the sample. The majority of the forest plantations and sawmills are located within the Eastern, Central and Rift Valley provinces, which were also selected for the research. These provinces can be seen from the Kenya map in Figure 6.1.

Because of logistical reasons, time constraints, infrastructural barriers and the wide distribution of the sawmills within the large provinces it was decided that not all districts of the three provinces could be selected to participate. Therefore, it was decided that sampling frame would have only ten districts out of the fifteen. Table 6.1 shows the selected districts and indicates the number of selected sawmills and their size categories.

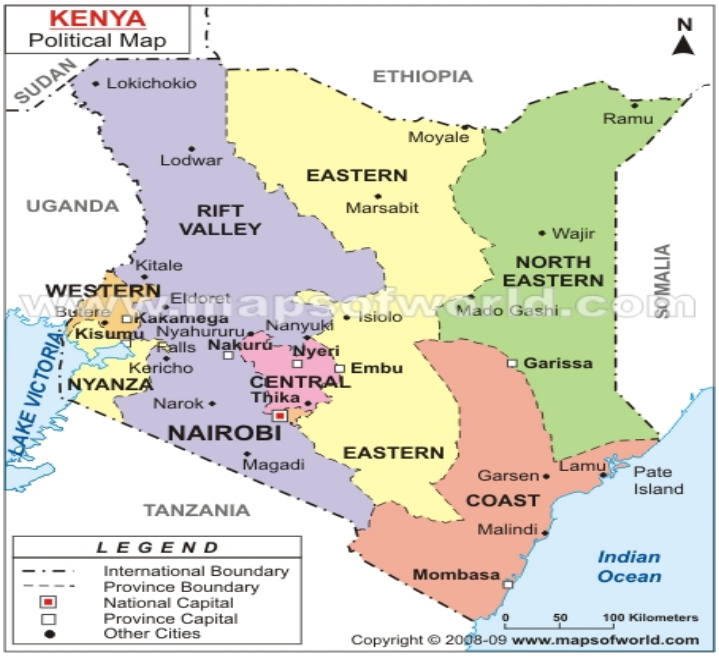


Figure 6.1 Kenya map showing the research areas (Mapsofworld.com 2008-09).

The following factors supported the decision made on the selection of the stratified random sampling, selection of the sampling frames, and identification of the units to the strata:

1. A proportional representation of the provinces and their districts wanted to be exhibited in the sample as effectively as possible.
2. The KFS had good statistics on the sawmills, their locations and the sizes.
3. In Kenya there were used to be 450 sawmills, from which 276 are registered. Out of these 276 sawmills 231 were located in the selected three provinces, representing of 83.7% of the registered sawmills. Out of these 231 sawmills 200 were located within the ten selected districts representing of 86.6% of the registered sawmills within the three provinces and 72.5% of all the registered sawmills in Kenya. The sample reflected the sawmill population accurately.
4. The different size of sawmills were well presented in the sample, because their portions in the sample followed the distribution of the sawmill population.

Table 6.1 Sampling results and the criteria for the simple random sample

Provinces, districts and sawmills sellected for the research

		Registered sawmills in the provinces					Sawmills in the sampling frame				
Province	District	Number and size of sawmill according to KFS prequalification inspection report (source: 2008 Mbaabu et al 2008).					Number and size of sawmills selected to the research				Selection criteria: Sawmills for the research were selected by simple random sample. Database for the selection was taken from the Prequalification Report of the Sawmills prepared by the KFS in 2008.
		Large	Medium	Small	Total	Province %	Large	Medium	Small	Total	
Rift Valley	Baringo			8	8	8 %				0	
	Keiyo	3	5	4	12	12 %				0	
	Kericho	1	2	4	7	7 %		1		1	2nd of the medium ones
	Koibatek	3	3	16	22	23 %		1	2	3	1st of the medium ones & 3rd & 8th of the small ones
	Nakuru	8	7	22	37	38 %	3			3	1st, 6th & 7th of the large ones
	Uasin Gishu	0	2	9	11	11 %			1	1	8th of the small ones
	SUBTOTAL	15	19	63	97	100 %	3	2	3	8	
Central	Kirinyaga		1	3	4	4 %				0	
	Kiambu	1	4	16	21	19 %		1		1	2nd of the medium ones
	Nyeri		2	49	51	47 %		1	3	4	2nd of the medium ones & 14th+39th+41th of the small ones
	Thika		4	10	14	13 %		1	1	2	1st of the medium ones & 2nd of the small
	Nyandarua	2	2	14	18	17 %		1	1	2	1st of the medium ones & 2nd of the small
	SUBTOTAL	3	13	92	108	100 %	0	4	5	9	
Eastern	Meru (Central & South districts)	1		13	14	54 %			3	3	1st+4th of the small ones (in Meru Central) + 1st of the small ones (in Meru South)
	Makueni &Machakos			7	7	27 %				0	
	Embu		2	3	5	19 %		1	1	2	1st of the medium ones & 1st of the small
	SUBTOTAL	1	2	23	26	100 %	0	1	4	5	
	TOTAL in all three provinces	19	34	178	231						
	Total in the research sampling frame	16	28	156	200		3	7	12	22	
	% from the sampling frame	8,0 %	14,0 %	78,0 %	100 %		13,6 %	31,8 %	54,5 %	100 %	

Drawing of the sample sawmills from the sampling frame was executed by drawing their advanced defined numerical position order from the list of the 276 registered sawmills. The final sample consisted 22 sawmills. The sample fraction n/N of the research was 22/200, where n is the sample size and N is the population size.

6.3 Content Analysis of the Research Material

The questionnaires were collected from 11% of the sampling frame sawmills. The response percentage was excellent as only the two sawmill representatives could not be conducted and interviewed and no more than one sawmill refused totally to participate in the survey. These three cases were replaced with new sawmills that were successfully interviewed.

Research analysis had several stages. It started with clustering the questions into thematically arranged groups, which focused to create answers that would generate information about the existing sawmill situations and problems occurring in sawmill operations and workers' competences. Data coding and analysis was carried out with the SPSS (*Statistical Package for Social Sciences*) and Microsoft Excel computer programs.

The main measures and indicators used for analyzing the results were frequency distributions, sample means and percentages for the variables. These were also the main descriptives for comparison of the variables. The results were presented and demonstrated in the summary tables of means, frequency distributions and percentages. When the frequencies were presented the valid percent of the frequency was used. The "0" and "Blank" answers that did not have any meaning or validity were not considered or counted. The frequency percentage shows only the portion of the answers included in the analyses.

Most of the summary tables were presented in the form of a count of the variables and their percentages of the total. In the analysis of the summary tables the most valuable and remarkable results were bolded or highlighted and commented on separately in the written paragraphs. Whenever the descriptive statistics were illustrated the mean was the indicator.

Some variables that had correlations were cross-tabulated to get a better understanding of the variables and to create more illustrative results and presentations. The thematic clustering of the variables into the bigger summary tables was done in order to facilitate more efficient analyses and simultaneous comparison of the variables. In the report these results were illustrated in the form of tables, graphs and charts to show the relationships and variations between the variables.

7 RESEARCH RESULTS

Twenty two sawmills, representing an even distribution of the Kenyan sawmills, were chosen to be the data source for this research. The results from the field survey are introduced in this chapter in the view of the sawmill technologies and technological development, sawmill production and its' limitations, education and training and eventually from the competence and competence development point of views.

The mean was used to describe the population parameters, which was derived from the Likert scales of the answers. The means that had a value of more than four (>4.0) were examined and reported. When the answers for "yes" or "no" questions were reported the frequency distributions and their percentages were used to determine the most valuable answers. The answers that had a value more than 50% were all reported and are analyzed. The open explanatory questionnaire questions that were asked after the Likert scale questions were reported and analyzed in the same way.

Whenever it was found, through the and interpretation of the tables, charts or figures, that some answers got a value of less than 50% with some extra value or valuable information, they were reported and analyzed accordingly. This was particularly the case when the sawmilling technology and the individuals' and enterprises' competence development aspects were concerned. The highest values of the results were highlighted in bold text. The values that were above the given limit or had some special value were italicized and bolded. If references are made to oral comments they are described "*into the citations with the italicized letters"*.

After describing the basic information about the survey respondents and the participating sawmills, in section 7.1, the other research results are presented in the thematically arranged order as explained in the section 6.2.2. This order was used because in this way the results could be presented in a logical sequence to form firstly an understanding of the sawmills' existing stage, secondly to note their development needs and finally to establish the basis for recommendations of the sawmills' and workers' competence development.

7.1 Characteristics of the Survey Respondents and the Kenyan Sawmills

This section 7.1 gives background information about the respondents and the sawmills. The variables measured included the respondents' age, basic education, professional education, occupation and professional experiences in sawmilling. The variables measured for sawmills included sawmill's age, size and ownership and the nature, type and age of the business as well as a comparison of the sawmills through workers' age, their number and daily production outputs in m^3 / day.

Research Respondents

The persons interviewed (n = 22) were 14 managers, four directors, two production managers and one accountant and secretary. One respondent was a woman and 21 were men. 21 (95.5%) of the respondents had a formal secondary education and just one (4.5%) had only a primary education. Figure 7.1 shows the professional education of the respondents. Nine of the respondents did not indicate their professional education, due to the fact that they did not have any.

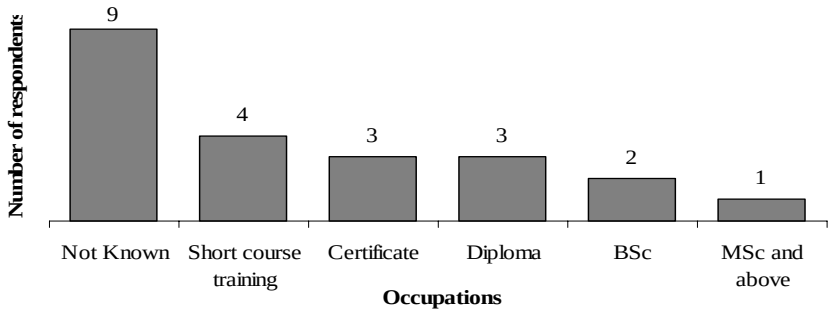


Figure 7.1 Professional education of the survey respondents

The research shows that 40.9% of the sawmill managers and owners had some kind of professional education, although it cannot be differentiated whether it was in forestry, wood technology, sawmilling or other not relevant disciplines to the field of sawmilling.

All the respondents of the research worked in the participating sawmills. Their age distribution was that five (22.7%) were below 35 years old, six (27.3%) were between 36 and 45 years, seven (31.8%) were between the 46 and 55 years and four (18.2%) were over 55 years old. The average age of the respondents was 45 years. Their average experience

of sawmilling operations was 17 years, from which period they had been an average of 14 years in their present position. Table 7.1 shows the descriptive statistics of the respondents. The basic information gathered from the respondents indicated that people working at the sawmills were in middle age and they had long working experience in sawmilling.

Table 7.1 Descriptives of the field survey respondents

Variables	n	Range	Min.	Max.	Mean	Std. Deviation
Age	22	38	25	63	**45**	10.4
Experience in the field	22	37	3	40	**17**	9.9
Years in the position	21	33	3	36	**14**	8.8

The respondents were also asked about their training needs and the subject areas they prefer. Two respondents (9.1%) answered that they do not need any training, two did not indicate their opinions, but eighteen (81.8%) pointed out that they need further training as illustrated in Figure 7.2, which indicates that the most relevant and important subject preferred was the sawmill technology followed by production management. These are indeed important areas, if the effectiveness of the sawmill operations and competences of the managerial personnel would like to be improved and developed.

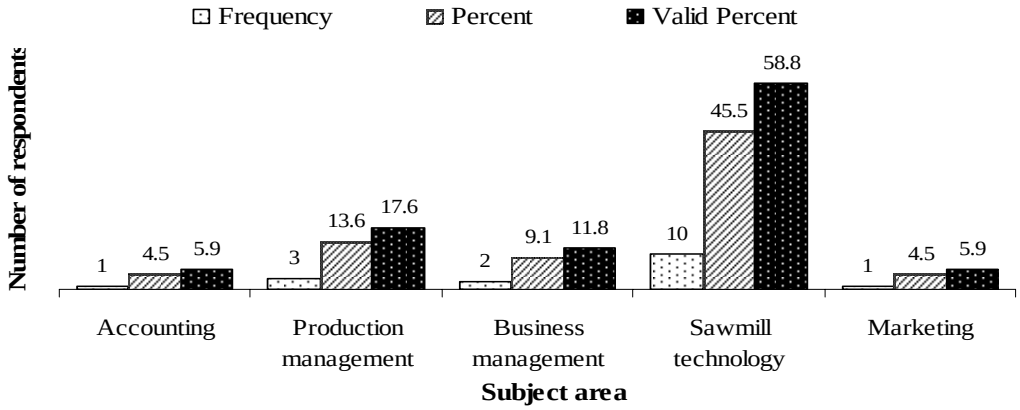


Figure 7.2 Professional training needs of the respondents

Characteristics of the Sawmills in Kenya

To identify the background of the participating sawmills and their business the respondents were asked various variables of the sawmill enterprises. This information was gathered in order to find out the present standing of the sawmills within the forestry sector and to find out the areas to be improved and developed in the future.

The 22 participating sawmills represented 7.97% of Kenyan sawmills. The results of the research indicated that the 22 participating sawmills were employing 750 employees. In accordance with this amount and the sample representation of 7.97% of the Kenyan sawmills, the present total sawmilling work force was calculated to be 9 410 employees, if the sawmills were operated in the present scale.

The oldest sawmill interviewed was founded in 1965 while the youngest ones were established in 2003. From that point of view it can be concluded that the sawmills' and their workers experiences and competences in sawmilling and enterprise management vary a lot. The average age of a sawmill in Kenya was 24.5 years. It can therefore be concluded that the sawmills had long traditions in wood processing, which was not seen in the development and productivity of the sawmills and the competences of their workers.

Ownership of the Sawmills

The research results show that 15 (68.2%) of the interviewed sawmills were private enterprises, three (13.6%) were corporations, two (9.1%) were partnerships and another two (9.1%) were co-operatives. All of these business entities were managed as privately owned wood processing enterprises consisting of different types of operations.

Labor Force in the Participating Sawmills and in the Kenyan Sawmilling Industry

The survey respondents were asked about the age and number of the sawmill workers working in their sawmills in order to find out the age structure of the sawmilling sector. The age groups were divided into three classes: below 30; 30-50; and over 50 years old. The results and distribution are shown in Table 7.2.

Table 7.2 Estimation of the sawmilling industry labor force in Kenya

Age group	**below 30**	**30-50**	**over 50**
Number of workers	323	385	42
Total in sampling frame (22 sawmills = 7.97%)		750	
Percent from the sampling frame	43.1 %	51.3 %	5.6 %
Estimated number of workers in each age group	**4 053**	**4 831**	**527**
Estimated total in sawmilling industry		**9 410**	

The results indicated that the labor force of the sawmilling industry in Kenya is young. This was based on the fact that 43.1% of the employees were below 30 years, more than half of the workers were 30-50 years and only 5.6% of them were more than 50 years.

Nature of the Sawmilling Business

Sawmilling was the main production operation in twenty one of the enterprises and plywood manufacturing in one of them. This unit also had a large scale sawmill that was included in the research. Table 7.3 indicates the main production operations that the enterprises were carrying out at the time of the research. Apart from these main operations some of the participating sawmills, particularly the large scale sawmills, carried out also other wood processing operations such as softboard production (1), plywood production (2), particleboard production (1), sawn timber further processing (1), construction business (1), selling of wood processing by-products (1) and selling of forest nursery products (1).

From Table 7.3 it can be seen that there were no mobile sawmilling operations in Kenya and there was no sawn timber exportation. The main reason for this was of course the logging ban that has affected the sawmilling operations since 1999. Secondly, mobile sawmilling operations have not been allowed within the industrial forest plantations, because of security and management reasons, but also because the KFS wanted to encourage people to utilize forest resources more effectively, which is provided when the raw material is brought and processed within the villages, towns or urban areas and therefore some of the by-products such as slabs and off-cuts can be used as firewood.

Table 7.3 Nature of business in the participating sawmill enterprises

Nature of business	**N**	**No**		**Yes**		**Total**	
		Count	%	Count	%	Count	%
Mobile sawmill	22	22	**100.0**			22	100.0
Fixed sawmill	22	1	4.5	**21**	**95.5**	22	100.0
Furniture and joinery manufacturing	22	9	40.9	**13**	**59.1**	22	100.0
Timber selling for domestic markets	22	2	9.1	**20**	**90.9**	22	100.0
Timber selling for export markets	22	22	**100.0**			22	100.0
Planing and molding	22	4	18.2	**18**	**81.8**	22	100.0

While the background information of the sawmills was asked, the respondents were also asked about sawmill development and their willingness and potential for the growth and

expansion of the sawmilling production operations. This was asked in order to know and analyze whether there is a need to develop and establish more efficient capacity building and competence development programs for both technological and human resources at the level of the enterprises and individuals. The results showed that as much as 90.9% of the sawmills were willing to expand their business, but with the condition that the business environment in forestry and wood processing must be stabilized and more reliable. One sawmill manager concluded that; *"the Kenya Forest Service must provide and facilitate equal forestry and wood processing opportunities to all registered wood processing enterprises without any limitations or favoring of the large scale entrepreneurs"*. The most important issues announced were constant and reliable raw material supply and improved training and education programs in forestry and sawmilling. Only 9.1% of the sawmills declined to show an interest and potential for expansion of their operations.

7.2 Sawmill Technologies and Technological Development

In order to find out and recommend the most suitable structures and development models for the development of workers' skills and competences it was important to observe and analyze the existing level of the production technologies and machinery in use. To do this the participating sawmills and their representatives were asked a number of variables about the existing sawmill technologies, the level and condition of the machinery in use, the maintenance of the machines and saw blades and finally the technological development of the sawmills. This was done in order to analyze the required competences and the qualifications required by the sawmills and their workers. Figure 7.3 illustrates the opinions of the survey respondents and the results achieved.

Production Technology, Machinery and Maintenance

According to the results, 59.1% of the respondents fully agreed that that their machines are old, but still function. The simple, old but well known sawmill machines, together with the workers' long experience have assisted the sawmills in keeping their machinery in working condition. 95.5% of the respondents agreed or fully agreed that their old machines were in good condition, although only 68.2% of the sawmills reported that they maintained their machinery well.

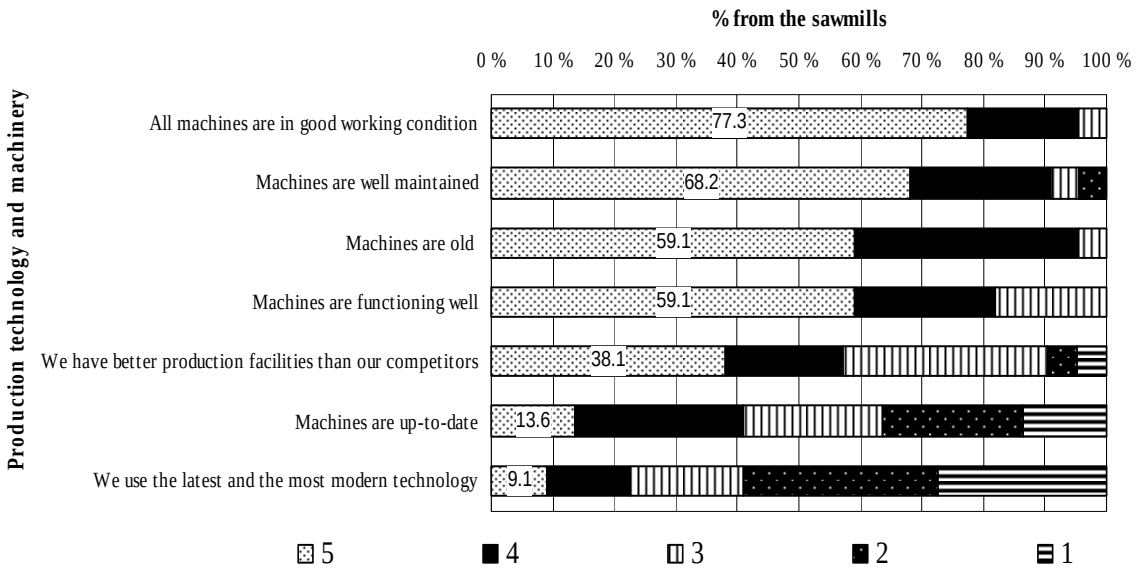


Figure 7.3 Sawmill machines and their maintenance in Kenya

The researcher observed during the oral discussions and interviews that the sawmillers were not aware of the sawmilling technologies available, because they were not able to identify and tell what type of technologies they want to use and they need. Therefore, they were not able to make any comparison, between their machinery, equipment, safety or production operations and as compared to the other better ones. The results showed that only about 40.9% of the sawmills (fully agreed or agreed) reported that they had up-to-date machines, meaning that their machines were exactly the type of machines the sawmill wanted to use. The sawmill owners and managers did not have any idea of getting more modern machines or equipment to replace their existing machinery. 22.7% of the sawmillers reported (fully agreed or agreed) that they used the latest and the most modern technology available. When the machinery was seen and observed it was not the truth, however this argument was partially true, because the sawmills that reported this were using a few newer, but not the latest technology machines than others.

Type and Age of the Sawmill Machinery

The results indicated that the age of the machines ranged from one year to a maximum of 60 years, which is a very old sawmill machine. There were a few newer machines that were only one to two years old, but these were only found in two large scale sawmills. These machines were small capacity bandsaw machines, which were used only as part of

the larger set-up. The calculated average age of the machines ranged from 22.4 to 24.5 years in all types of machines and their location categories at the sawmill set-ups.

Variables about the different types of sawmill machines are summarized in Figure 7.4. The most common sawmill machine was a circular saw machine used for breakdown and resaw purposes. Photograph of the typical circular saw machine is attached in Appendix 4 in the photo 1. These type of machines were used at an average of 80% of the sawmills. Mostly they were locally manufactured circular breakdown machines or so called roller benches. They were simple to use, manually operated, but with several problems. This was because of lack of local manufacturing knowledge, and lack of maintenance and service. Circular saw machines were more used in the SMS sawmills than in the large scale sawmills, where the bandsaw machines were used together with the circular saw machines.

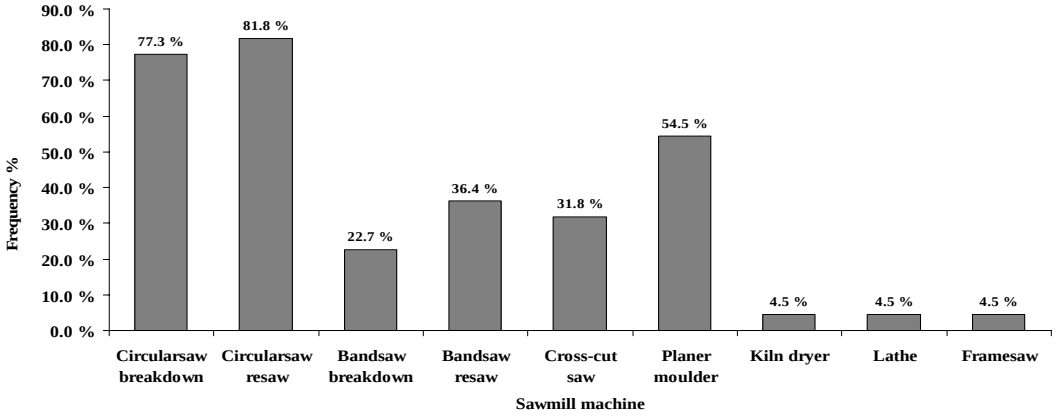


Figure 7.4 Machines used for cutting of wood

The reason that circular saw machines were used in so many sawmills was that they were found to be very simple, their maintenance was found easy, they were found to be reliable due to their simple mechanism, spare parts were minimal and available in Kenya and the workers had operated them for many years. Also, saw blade maintenance was found to be easier and cheaper than with the bandsaw machines.

Figure 7.4 shows that the bandsaw machines are not as commonly used as the simple circular garage breakdown and circular roller bench re-sawing machines. This was because of the high investment costs of the sawmill and its machinery, more demanding operations and machine maintenance, more expensive sawdoctoring and more challenging saw blade maintenance. Another reason that band saw machines were not so commonly

used was the low level of workers' competences and professional skills in bandsawing operations and the use of the bandsaw technologies. The bandsaw machines were more common in the large or medium scale sawmills than in the small scale sawmills. Another observation made was that the SMS sawmills were using bandsaws for re-sawing the cants rather than using them for cutting of logs, which was done by the circular saw machines. Photograph of the typical bandsaw machine is given in Appendix 4 in the photo 2.

The other main machines that were used in the sawmills were cross-cut saws and planer-molders. The results shows that the cross-cut saws were only used in about one third of the sawmills, which meant that sawmills were not squaring the ends of the sawn timber pieces and neither they did not try to upgrade the quality of sawn timber by removing and cross-cutting the poor quality ends or less valuable portions of the sawn timber. This was obviously a consequence of lack of awareness in wood product qualities and the poor attitude of workers and customers towards higher or even better quality products.

Machine Maintenance

Variables on machine maintenance and maintenance of the saw blades, as part of the sawmill techniques, were asked from the respondents. The sawmills were asked about their maintenance schedules and who performs the maintenance activities. These were asked in order to know how maintenance of machinery was arranged, were there any problems and if yes, what were the main difficulties. Maintenance activities that were carried out were very basic because of the simple and old machinery. The maintenance activities were carried out in 54.5% of the sawmills on weekly basis, 36.4% on a monthly bases, 13.6% on a daily basis and only 9.0% of the sawmills carried out maintenance on an annual basis. One of the sawmillers said that; *"we don't maintain our machines, but we only repair them when they break down. That's all we know about machine maintenance, so why should we spend our time for that when the machines are functioning somehow"*.

In 63.6%, 72.7% and 36.4% of the sawmills respectively the mechanics, sawdoctors and machine operators carried out the maintenance activities. The sawdoctors and mechanics were responsible for maintenance activities, because the mechanics were able to maintain the machinery and the sawdoctors were capable of maintaining the saw blades. Sawmill

managers told that together, combining of their knowledge and competences, they are able to solve most of the sawmill problems and they can keep the sawmill operating.

Some sawmill owners and managers emphasized the meaning and importance of sawdoctors and the maintenance of saw blades. One manager said that; *"without a good sawdoctor, the sawmill is like a church without a priest, which cannot provide its services"*. Fifteen managers complained about the lack of training in machine maintenance and sawdoctoring. They said that sawdoctoring and maintenance of saw blades are the most important areas in sawmilling operations and in this respect we definitely need training of our workers. One manager concluded the whole issue by saying; *"too many costly mistakes have been made due to the trial and error methods that our workers have done in the machine repairs that were caused by non-existence of preventive maintenance and poor competences of workers, maintenance personnel and management"*.

Only two sawmills of the 21 informed that they have difficulties in machine and mill maintenance. Through the survey observation it can be confirmed that this cannot be the truth because most of the sawmills had serious problems with their machinery. The survey results indicated that the problems were mainly encountered because of imported machines and unavailability of the spare parts in Kenya. 17 sawmills out of the 22 reported that they don't have any problems with spare parts. This was because the machines they used were locally manufactured and of simple construction. Only one sawmill complained that their machines were too old to get any spare parts. The sawmill workers reported that most sawmills neglected frequent preventive maintenance, which caused serious and frequent machine breakdowns. The sawmill managers told that there is no appreciation of machine maintenance due to low level of awareness and lack of professional education and training.

Sawdoctoring

In the 22 sawmills visited 72.7% used a so-called "experienced sawdoctor" who had long experience but no professional training at all. Only 27.3% of the sawmills used Sawdoctors that were trained at the FITC a long time back. The sawmill owners and managers of those sawmills were happy with the sawdoctors' work performance and the quality of the saw blades. The only complaint and concern they had was the future,

the time when the "older sawdoctors" will quit their work and there are no trained sawdoctors who could replace well trained and experienced older craftsmen. The sawdoctoring operations and maintenance of the saw blades was monitored at all sawmills visited. Generally they were poorly executed. Saw blade maintenance was performed with very low care and inadequate competences leading to high saw blade costs, high machine downtimes and breakdowns, poor product qualities and low raw material recoveries.

Currently 75% of the sawdoctors are working without any proper training. When queried about why they have not been trained the answer of many sawmill managers explains the whole situation; *"there is no sawdoctoring training available in Kenya, although we need it and there are excellent facilities available at FITC in Nakuru"*. The following were the comments of the sawmill owners and managers in relation to sawdoctoring:

- *"When FITC was operational, before the year 2000, there were lot of good training courses on sawmilling, sawmill machine maintenance and sawdoctoring and we had qualified sawdoctors and sawmill workers."*
- *"Earlier our sawmills did not have any problems in maintaining the saw blades, but today the situation is serious, because there is no training at all*."
- *"Lack of sawdoctoring and tool maintenance has many consequences to our sawmilling operations and sawmills' problems today*."
- *"Our sawdoctors were trained at FITC Nakuru in 1986. They were good at that time, but now they are getting old. Many of them have retired already and there are no new trained ones available so soon we have a real problem in sawdoctoring."*
- *"FITC training and services were excellent and helped us a lot, but currently they are not available, although the training facilities still exists in Nakuru"*.

Examples and photos of the sawdoctoring practices are shown in Appendix 4 photos 5-6.

50% of the sawmills complained that there is a big need for training in machine and saw blade maintenance, but there is no active and operational sawmilling training institution in Kenya that could provide special training for maintenance personnel. Although there were various problems and difficulties in sawdoctoring and sawmill maintenance the external service providers were only used in 33.3% of the sawmills.

The reason for this was unavailability of training and availability of trained and competent sawdoctors and maintenance personnel.

Sawn Timber Drying

Sawn timber drying is a prerequisite for high quality final wood products and it is especially a must for value-added wood products such as panels, cornicing and moldings. These variables were asked in order to know the sawmillers' abilities and competences in sawn timber drying, wood preservation and further processing of sawn timber. The results were shocking because 68.2% of the sawmills did not dry any sawn timber before they sold it or delivered it to their customers. One sawmiller concluded the discussion by saying that; *"there is no time to do any seasoning or drying of sawn timber because the demand is much higher than we can supply and there is a lot of extra work and costs involved"*.

68.2% of the sawmills were not seasoning sawn timber at all, only 22.7% of the sawmills were partially seasoning and no more than 9.1% of the sawmills used kiln dryers. Drying was only done on customers' special request. Kiln drying was all done by the large scale sawmills. The three main reasons for not drying sawn timber were high demand for sawn timber (33.3%), the customers' low appreciation and respect (33.3%) for dry sawn timber and the customers' lack of understanding to use dry sawn timber and wood products.

Technological Development

Under this topic the survey respondents were firstly asked variables about their knowledge and understanding of the technologies and technological development of the Kenyan sawmilling industry. Secondly, they were asked about their understanding and willingness to develop their sawmills. Thirdly, they were requested to indicate their knowledge and competences on technological development aspects in sawmilling and finally they were queried about the methods to be used in improvement of the existing situation. Table 7.4 shows the results.

When the level of technologies was asked nearly 80% of the sawmills indicated that their production technologies were appropriate for the local conditions at present.

Obviously this was the case, because there were no better or more modern technologies available within the country. The sawmillers were also queried about their willingness to purchase new machinery to improve their enterprise competitiveness and technologies. Over 90% of the sawmills were of the opinion that they need to invest in new technologies and machinery in order to compete. The same amount of sawmills also agreed that production technologies keep changing fast and therefore sawmills need to follow the development actively. Another aspect that they also agreed upon (77.2% of sawmills) was the sawmills' co-operation on the technological development with other sawmills. The respondents found it important and beneficial to establish networks and co-operation. 50.0% of the sawmillers reported that they did not have any knowledge and information about the modern and more appropriate sawmilling technologies available. These aspects were further asked.

Table 7.4 Consideration of technological development in Kenyan sawmills

Technology development	**N**	**1**		**2**		**3**		**4**		**5**		**Mean**
		Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	
In case we invest for new machines and equipment we should train our personnel	22	0		0		0		4	18.2	18	**81.8**	4,82
Networks and co-operations are important to survive in business	22	1	4.8	0		1	4.8	2	9.5	17	**81.0**	4,41
We should purchase new technologies in order to compete	22	0		0		1	4.5	4	18.2	17	**77.3**	4,73
Appropriate production technologies keep changing fast and we should follow the development	22	0		0		2	9.1	3	13.6	17	**77.3**	4,68
Production technologies we use are appropriate for the local conditions	22	1	4.5	2	9.1	2	9.1	3	**13.6**	14	**63.6**	4,23
Need to develop our production technologies together with other sawmills	22	2	9.1	1	4.5	2	9.1	3	**13.6**	14	**63.6**	4,18
No well trained personnel to operate the latest technology and most modern machines	22	1	4.5	1	4.5	1	4.5	9	**40.9**	10	**45.5**	4,18
Don't have competencies to master new production technologies	22	4	18.2	0		3	13.6	6	**27.3**	9	**40.9**	3,73
Know type of technology we should use and purchase	22	6	27.3	2	9.1	3	13.6	6	**27.3**	5	**22.7**	3,09
Have good understanding of new technologies available	22	7	**31.8**	4	**18.2**	2	9.1	5	22.7	4	18.2	2,77

The results also indicated that if any investments in new sawmilling technologies would be made and new machinery brought in there would be no competent personnel available to operate them. 86.5% of the sawmills agreed or fully agreed with this statement. The results also indicated that 18.2% of the sawmills agreed and as much as 81.8% of the sawmills fully agreed that, if new sawmilling technologies are introduced, which is indeed required, sawmill personnel must be trained. This means that vocational education and training in sawmilling must be re-started in order to have competent workers to operate the new technologies and more modern machinery.

7.3 Sawmill Production and its Limitations

Other issues that that can indicate the level of workers' competences are the raw material utilization and recovery, the quality of sawmill products, sawmill capacity and production volumes, sawmill productivity and sorting and grading of sawn timber for value adding. Analyzing these aspects will tell us whether the individuals and enterprise have the required competences for sawmilling production operations, whether they are able to achieve the best possible raw material utilization and are capable to produce the highest quality and value wood products; or whether they need training.

Raw Materials Used at the Sawmills

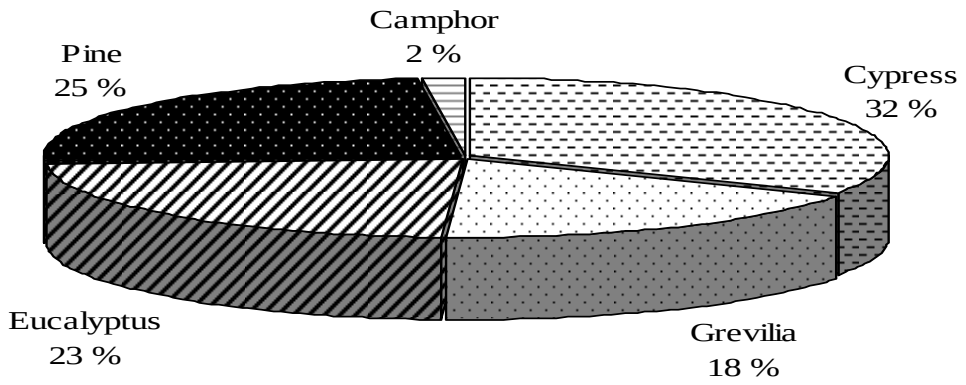


Figure 7.5 Wood raw materials used at the Kenyan sawmills by volume

Figure 7.5 shows the structure and distribution of the different type of raw materials that the sawmilling industry and the sawmills used in Kenya. The volumes were asked about and calculated in cubic meters (m^3).

One of the indicators of sawmill performance and workers' competences is the raw materials recovery rate, which shows how much of the raw material can be recovered and how much sawn timber or wood products can be processed from the available raw material. Information about the sawmills' daily capacities were asked in order to calculate these variables. This information was needed when the raw material recoveries were calculated and when the competences of the workers in this respect was analyzed.

Muthike (2006) wrote that the raw material recovery rate in Kenyan sawmills was ranging between the 23 to 46 percent depending on the type of the machinery and method used for cutting. Factors affecting the recovery rate are various. In Muthike's report the training of sawmill operators was one of them. He concluded in his report that the competences and professional skills of the workers working in the forestry and sawmilling were others affecting the recovery rate remarkably. (Muthike 2006 1-7.) The raw material recoveries that were calculated in this research shows the similar trend that Muthike got in his study. Current raw material recoveries were very low, as it is shown in Table 7.6. This means that raw material utilization was also very low and therefore it can be assumed that sawmill workers competences are not as required in effective sawmill operations.

Sawmill Production Volumes, Capacities and the Recovery of the Raw Material

The main product that sawmills produced was sawn timber. It was produced by 95.5% of the sawmills. Other products that sawmills produced were mainly moldings and planed timber. This was done in 59.1% of the sawmills. Doors and windows were minor products and were produced only in 18.2% of the sawmills.

The sawmill representatives were also asked about their sawmill's projected capacities. This was done in order to estimate the input and output volumes and the installed capacities of the sawmilling industry as well as to calculate the recoveries. These variables were also asked in order to analyze whether the sawmill owners and managers have required competences in sawmill management and records keeping procedures.

The production volumes and sawmill capacities were calculated, although most of the sawmills had very inefficient production records. These calculations were based on the oral

information received from the sawmill owners and managers. The sawmill productions, installed capacities and recovery rates are shown in Tables 7.5 and 7.6.

Table 7.5 Daily production capacities of the sawmills

Product	N	Range	Minimum	Maximum	Mean	Std. Deviation
Sawn timber production (m3/day)	21	50.4	2.1	52.5	**14.2**	13.04
Sawn timber further processing (%)	11	46.0	10.0	56.0	**31.5**	15.34

Table 7.5 shows that the average daily production of a sawmill was 14.2m^3 of sawn timber per day, ranging from 2.1m^3 to 52.5m^3. This made the average annual production of the sawmill 3 408m^3, when operating five days a week and 48 weeks per year. The annual production of all the registered 276 sawmills and the whole sawmilling industry in Kenya was estimated to be about 940 000 m^3 per year. This result was much higher than Spears calculated and estimated in 2005. The annual volume calculated in this research was high, which was mainly caused by unrealistic production records that were results of poor or none-accurate production records of the sawmills. Actual fact there were no records at the sawmills and therefore the sawmillers just estimated or guessed their sawmill input and output volumes at the time of the interview. This resulted little unrealistic total annual volume, which however must be accepted as one result and finding of this research.

Table 7.6 Installed sawmill capacities and raw material utilization

Variables	N	Range	Minimum	Maximum	Mean	Std. Deviation
Raw material **in put (m3/day)**	21	255.9	6.6	262.5	**51.4**	60.46
Sawn timber **out put (m3/day)**	21	81.9	2.1	84.0	**18.5**	21.94
Raw material in put **(m3/annum)**	21	61 425.0	1 575.0	63 000.0	**12 426.9**	14 465.82
Sawn timber out put **(m3/annum)**	21	19 656.0	504.0	20 160.0	**4 509.7**	5 231.07
Recovery of raw material **(%)**	16	35.0	20.0	55.0	**39.4**	10.21

Table 7.6 shows that the average input volume of the sawmill was 51.4m^3 per day and 12 426.9m^3 per year whereas the output volumes were 18.5m^3 and 4 509.7m^3 respectively. These volumes gave raw material recoveries of 36.0% and 36.3% respectively, when calculated from the given production volumes. Muthike indicated in his study of 2005 that an average recovery rate of the sawmill was about 38.7%, if bench, circular saws and bandsaw machines were used. The results of this study were in relation to Muthike's study.

The 16 sawmill managers also informed their sawmill's recovery rate or actual fact they just gave their "wild guess" of the recovery. The average of these gave a recovery of 39.4%, which was differing from the figures calculated from the given production volumes. Six sawmills were not able to tell the raw material recovery. In this respect it can be concluded that the sawmill managers or owners did not understand the concept of recovery at all and they did not have reliable records or possibly they did not want to tell the real figures for some other reasons.

The results achieved in this category indicated that some of the sawmillers did not understand the concepts of sawmilling, production calculations/record keeping, follow-up and management of the sawmill at all. This indicated also that their competences in sawmilling operations and management were really low and their attitude towards improvement and development of their sawmill business operations not clear at all.

Sorting and Grading of Sawn Timber

Sorting of sawn timber according to various dimensions was done at every sawmill for various reasons. 47.6% of the sawmills sorted sawn timber because the customers demanded it, otherwise they would not have done it. 33.3% of the sawmills sorted their sawn timber because it was easier to sell. Only 19.0% of the sawmills (four sawmills out of 21) sorted sawn timber for economic reasons in order to get higher prices. By grading of the sorted sawn timber its value can be increased, leading to better economic results for the sawmilling business. Five sawmills of the 22 did not answer this question at all. Most of them explained that they do not understand the concept and importance of sawn timber grading.

Sawn timber grading was done only in 5 sawmills out of the seventeen who answered this question. Four of them graded sawn timber for economic reasons in order to get higher prices for their products. One sawmill graded its sawn timber because their customers appreciated it and they achieved a better economic result for the business. Although the five sawmills reported that they graded their sawn timber, all of the 17 sawmills were asked about the reasons for not grading. The most common reasons were that the customers did not demand (7 sawmills) and they did not appreciate (5 sawmills) grading of sawn timber. Other smaller

reasons for not grading the sawn timber were that there was no demand for graded sawn timber (3 sawmills) and that the grading rules were not known (2 sawmills) by the sawmill.

Table 7.7 Sorting and grading of sawn timber

Variables	N	Grading of sawn timber				Sorting of sawn timber	
		No		Yes		Yes	
		Count	%	Count	%	Count	%
Customers demand sorting into dimensions	21					10	**47.6**
Sawmills get higher product prices when sorted	21					4	19.0
Products sell better when sorted	21					7	**33.3**
Demand for sawn timber is too high	17	3	17.6				
Customers do not demand grading	17	**7**	**41.2**				
Customers do not appreciate	17	**5**	**29.4**				
Sawmills get higher prices when sawn timber is graded	17			**4**	**80.0**		
Customer appreciation	17			**1**	**20.0**		
Grading rules are not known	17	**2**	**11.8**				

Value Adding of Sawn Timber

Value adding of sawn timber was found in less than half of the sawmills. The main activities were furniture making and wood preservation. Figure 7.6 shows that more than 50% of the sawmills had planer moulder and woodworking machines. These machines were however, on most occasions, used only for up-grading of sawn timber dimensions and surface quality because the customers demanded that.

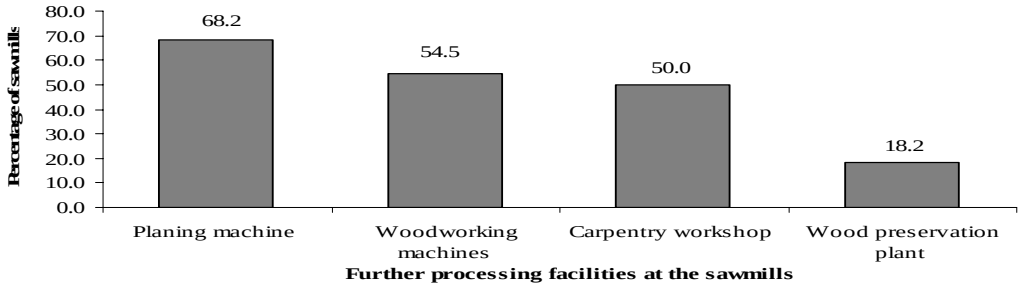


Figure 7.6 Further processing facilities and machines at the sawmills

Production Constraints and Limiting Factors of the Sawmills

The sawmill respondents were asked various variables about the production constraints and factors limiting their sawmill production operations. These variables were asked in order to

find out whether the workers' competences and lack of training are part of the limiting factors. These factors often indicate the areas that need to be improved and developed as well as give directions and ideas about which type of competence development programs and capacity building should be established and to whom these should be directed. Table 7.8 shows the results. The variables that had more than 50.0% value were analyzed.

Table 7.8 Sawmilling production constraints and limiting factors

Factors limiting production	**N**	**No**		**Yes**	
		Count	%	Count	%
Sawmill Machinery	22	6	27.3	16	**72.7**
Working capital	22	9	40.9	13	**59.1**
Sawdoctoring equipment	22	13	59.1	9	40.9
Transport equipment	22	16	72.7	6	27.3
Technical manpower	22	11	50.0	11	**50.0**
Cost of raw material	22	5	22.7	17	**77.3**
Insufficient capacity	22	14	63.6	8	36.4
Government regulations	22	12	54.5	10	45.5
Office manpower	22	21	95.5	1	4.5
Raw material	22	2	9.1	20	**90.9**
Price control	22	16	72.7	6	27.3
Competence of workers	22	9	40.9	13	**59.1**
Handling of materials	22	10	45.5	12	**54.5**
Space for expansion	22	19	86.4	3	13.6
Availability of raw material	22	2	9.1	20	**90.9**
Cost of raw material transportation	22	6	27.3	16	**72.7**
Maintenance of machinery	22	14	63.6	8	36.4
Casual labors	22	21	95.5	1	4.5
Capital	22	14	63.6	8	36.4
Raw material quality	22	11	50.0	11	**50.0**
Infrastructure	22	12	54.5	10	45.5
Legislations	22	15	68.2	7	31.8
Maintenance tools	22	21	95.5	1	4.5
Cost of labor	22	14	63.6	8	36.4
Market information	22	19	86.4	3	13.6
Spare parts availability	22	17	77.3	5	22.7

The most significant factor limiting the sawmill production operations was the lack and unavailability of the raw materials (90.9% of the respondents). The second highest was the high cost of raw material (77.3%). The third one was the high expenses of raw material transportation (72.7%). The fourth one was the poor quality of raw material (50.0%). The first constraint was directly in relation to the existing logging ban that affected the availability of the raw material. This also lowered the raw material quality and reduced sawing operations, because the sawmillers bought their raw material from any source. Even from the farmers, who are not professionally trained foresters or sawmillers and who do not have proper knowledge and skills in forestry and forest harvesting operations. The second and third factors were indirectly linked to the lack of competences in sawmill

production management. This is because of the low raw material recovery, which increased the cost of raw material and at the same time the expenses of transportation.

Another significant limiting factors that affected production operations were inefficient sawmill machinery in 72.7% of the sawmills, low competence of workers in 59.1% of the sawmills and the level of the technical manpower in 50.0% of the sawmills. Owners' and managers' poor know-how in sawmill management were already observed and reported to be one of the most critical development areas. Due to their limited competences, abilities and poor attitudes they are not able to analyze and understand the production constraints that affect their production operations.

Co-operation and Networking of the Sawmills

The survey respondents were also questioned about the co-operation and networking between the sawmills, services providers, subcontractors, resellers, customers, and training and research institutions. These were asked in order to know whether any exchange of experiences and competences existed between the sawmills. The first impression was that the interviewed managers and owners did not understand these concepts. The results supported this. All the sawmills (100%) indicated that their most important co-operation partners were the final customers and the end users, which obviously are not the co-operation partners, but the customers. The results further indicated that resellers and dealers of sawn timber (54.5%) were the second most important co-operation partners. This is the same as the earlier situation and explanation.

Figure 7.7 shows the types of business and co-operation partners and networks that exist at the moment and how many of those the sawmills have. If considering the exchange of experiences and competences the results showed that there was some co-operation between the 54.5% of the sawmills. If the customers, dealers and resellers were not considered as partners, only less than 36.4% of the sawmills had co-operation partners or networks in which they exchanged experiences and competences. The results indicated that more than two thirds of the sawmills did all their operations and activities on their own rather than trying to work together, co-operate or network with other sawmills.

Sawdoctoring and maintenance of the saw blades was indicated as the most advanced area of co-operation and networking. This was because most of the sawmills did not have the adequate tools and equipment to maintain the saw blades, they did not have the required competences to do the work and their sawdoctors were not professionally qualified.

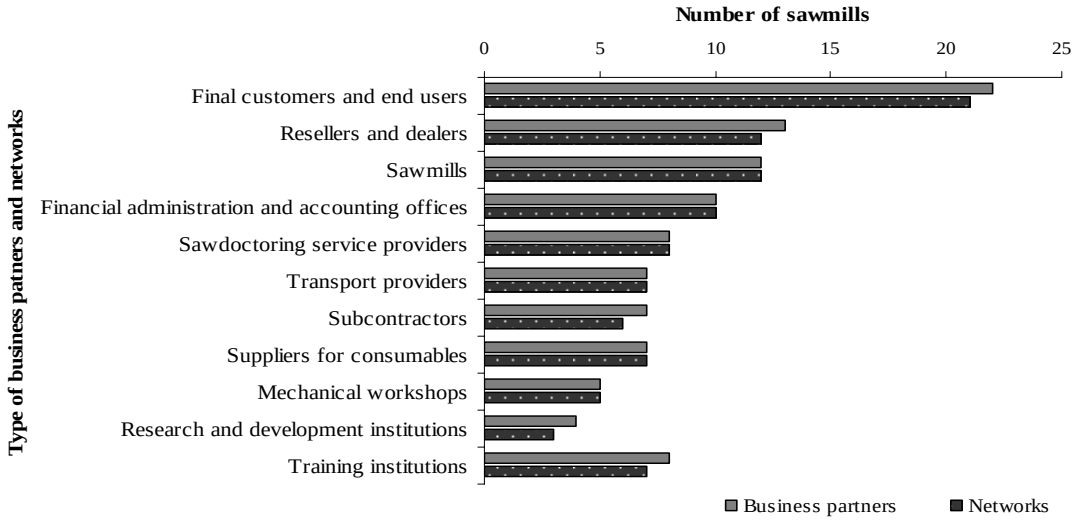


Figure 7.7 Business partners and networks of the sawmills

The results also indicated that sawmills had very little co-operation and networking with the research and training institutions. Only one sawmill (4.5%) indicated that they had some co-operation with the research institute. 31.8% of the sawmills indicated that they had some co-operation with the training institutions, although they told that it has been very little since the closure of the FITC in Nakuru. One sawmill manager said that; *"we had successful co-operation with FITC when it was operational about ten years ago, but at present there is no training institution that we can conduct or communicate with. Currently there is no training available. What a pity that such a good training facilities are under utilized when there is a big need of training in the country"*.

7.4 Education and Training in Sawmilling

Capacity building and competence development are closely linked to education and training, and in this research to vocational adult education and further training in forestry and sawmilling. To find out the existing level of the workers' knowledge, competences and professional skills various variables were asked about the employees' formal and vocational education. This information was gathered in order to obtain background

information on the Kenyan sawmilling industry personnel and to facilitate information for establishment of the sawmill workers' competence development programs.

Firstly, the sawmillers were asked whether they believe that success of the sawmill can be built up by development of the competences and improvement of the workers capabilities. 21 sawmills (95.5%) considered that their sawmill can build up better success through human resources development and competence development. One director emphasized that; "*right substances areas must be selected for the training and correct teaching methods for adult learners. Training courses must be offered in frequent basis and the training must be affordable to all sawmills and their workers*". Only 4.5 % of the sawmill owners and managers had negative respect towards training and development activities.

Secondly the respondents were asked about their present agreements with the training institutions and their willingness to make new agreements, if offered. 95.5% of the sawmills pointed out that they did not have any agreements with any training organizers or institutions. Furthermore, when they were asked about their willingness to make agreements with the training institutions 19 sawmills (86.4%) were ready to do so. However, they emphasized that they would make the arrangements with the wood technology training institutions only, if appropriate and comprehensive education and training in forest harvesting operations, wood technologies and sawmilling are offered.

Thirdly, the different aspects of formal and vocational education and training were inquired. These were asked in order to know the workers' basic abilities to learn and participate in training programs and to know their existing level of professional education. Detailed results of the basic education in each worker group are shown in Table 7.9 and the professional education in Table 7.10.

The Basic Education of the Sawmill Workers

The research results provided evidence that sawmill workers' basic education was at a good level. 65.1% of the workers had a primary, 34.0% had a secondary, 0.8% had higher than secondary and only 0.1% of the workers' did not have any basic education.

Table 7.9 Level of sawmill workers basic education

OCCUPATION	Basic Education (No. of workers)								Group Total	
	Not Known		Primary		Secondary		Others			
	Sum	Sum %	Sum	Sum %	Sum	Sum %	Sum	Sum %	Sum	Sum %
Sawmill manager					21	2.8	1	0.1	**22**	2.9
Accountant					7	0.9			7	0.9
Circular breakdown saw machine operator			7	0.9	23	3.1			**30**	4.0
Sawdoctor	1	0.1	6	0.8	17	2.3			24	3.2
Lorry driver			23	3.1	4	0.5			27	3.6
Helpers/Casual labour			340	45.3	16	2.1			**356**	47.5
Electricians					9	1.2			9	1.2
Director			1	0.1	5	0.7			6	0.8
Salesman					1	0.1			1	0.1
Watchman			22	2.9			4	0.5	26	3.5
Carpenters/wood working machine operator			13	1.7	22	2.9			**35**	4.7
Loggers/Powersaw operators			26	3.5	5	0.7			31	4.1
Supervisors			6	0.8	13	1.7	1	0.1	20	2.7
Circular resaw machine operator			8	1.1	18	2.4			26	3.5
Bandsaw breakdown machine operator			6	0.8	19	2.5			25	3.3
Band resaw machine operator			5	0.7	27	3.6			32	4.3
Planner moulder machine operator			1	0.1	12	1.6			13	1.7
Cross-cut machine operator			4	0.5	2	0.3			6	0.8
Logging manager					6	0.8			6	0.8
Clark/Tally clark			3	0.4	25	3.3			28	3.7
Tractor driver			17	2.3					17	2.3
Secretary					2	0.3			2	0.3
Mechanics					1	0.1			1	0.1
Group Total	1	0.1	**488**	**65.1**	**255**	**34.0**	6	0.8	**750**	100.0

The Professional Education of the Sawmill Workers

84.0% of the sawmill workers did not have any professional education or training at all. 8.1% had short course professional training that had been one to 12 weeks long and which was mainly received from the FITC in Nakuru, when the institute was still operational before the year 2000. The remaining 7.9% had either a college or university professional education including 6.0% of certificate holders and 1.5% of diploma holders. Only 0.1% of the workers, mainly directors and managers, had a B.Sc. and 0.3% a M.Sc. degree. Nine (40.9%) of the managers of the 22 sawmills had higher education than certificate level. Thirteen (59.1%) of the respondents did not have any professional education. The results in this respect clearly indicated that managers had better vocational education than the workers.

Table 7.10 Level of the sawmill workers' professional education

OCCUPATION	Professional education (No. of workers)												Group Total	
	Short course training		Certifi-cate		Diploma		BSc		MSc and above		No professional training			
	Sum	Sum %	Sum	Sum %	Sum	Sum %	Sum	Sum %	Sum	Sum %	Sum	Sum %	Sum	Sum %
Manager	4	0.5	3	0.4	**4**	0.5	**1**	0.1	**1**	0	9	1.2	22	2.9
Accountant	5	0.7			1	0.1					1	0.1	7	0.9
Circular breakdown saw machine operator	5	0.7	5	0.7							**20**	2.7	30	4.0
Sawdoctor	11	1.5									13	1.7	24	3.2
Lorry driver	11	1.5									16	2.1	27	3.6
Helpers/Casual labour											**356**	47.5	356	47.5
Electricians			3	0.4	**6**	0.8							9	1.2
Director	2	0.3	1	0.1					**1**	0	2	0.3	6	0.8
Salesman	1	0.1											1	0.1
Watchman											**26**	3.5	26	3.5
Carpenters/wood working machine operator			15	2.0							**20**	2.7	35	4.7
Loggers/Powersaw operators											31	4.1	31	4.1
Supervisors	1	0.1	6	0.8							13	1.7	20	2.7
Circular resaw machine											**26**	3.5	26	3.5
Bandsaw breakdown machine operator	8	1.1	6	0.8							11	1.5	25	3.3
Band resaw machine operator	2	0.3									**30**	4.0	32	4.3
Planner moulder machine operator	2	0.3									11	1.5	13	1.7
Cross-cut machine operator			1	0.1							5	0.7	6	0.8
Logging manager	1	0.1									5	0.7	6	0.8
Clark/Tally clark	6	0.8	5	0.7							**17**	2.3	28	3.7
Tractor driver											17	2.3	17	2.3
Secretary	1	0.1									1	0.1	2	0.3
Mechanics	1	0.1											1	0.1
Group Total	**61**	8.1	**45**	6.0	**11**	1.5	**1**	0.1	**2**	0	**630**	**84.0**	**750**	100.0

The main sawmill machine operators such as the circular breakdown saw machine operator, the circular resaw machine operator, the bandsaw breakdown machine operator and the band resaw machine operator are the key workers in the sawmilling operations. They will ensure the effectiveness and productivity of the sawmill, if they can operate and maintain the machines correctly and efficiently, but in order to do that they need training. The research results showed that 33.3%, 0.0%, 56.0% and 6.6% of them had professional education or further training respectively. This made only an average of 23.0% of the sawmill key workers trained professionally. In fact, this was a clear indication of low professional education level and therefore obviously too low competence level and professional skills at the leading sawmilling occupations. This is also an answer to various production constraints and difficulties in production. The results also indicated that

professional training of the sawmill supervisors (35.0% trained) and the tally clerks (42.8% trained), that are other important workers of the sawmill operations, was too low.

Type of Education or Training Preferred

The sawmillers were asked about the vocational education and training they would prefer for their personnel in case it would be available in forestry and sawmilling. These aspects were asked from the sawmill managers, foremen, supervisors, machine operators, sawdoctors and mechanics point of view. The variables that were asked in this respect included formal vocational education, in-house training, short course training, tailor-made courses and apprenticeship training. Table 7.11 shows the detailed results.

The results indicated without a doubt that the sawmills do not like to invest in formal vocational education. The following comments supported this statement:

- *The most important is to get quick on the spot training at the sawmill on mill and production management, sawdoctoring and machine maintenance.*
- *We prefer shorter courses training that we can afford.*
- *Extension services and technical assistance are the best, because at the same time we can solve our problems, develop the existing machines and methods and we can train our workers at our own sawmills.*
- *All types of technical assistances at the sawmills is highly appreciated".*

The most preferred training for supervisors, foremen and managers was the short course training that is either arranged at the sawmill or at FITC in Nakuru. One sawmill manager concluded this well saying that; *"arrange the managerial training at our various sawmills so we get the best possible benefit from your training, we learn from each others and we can build up the networks at the same time. FITC short courses in sawmilling and maintenance were excellent, but why are those not offered anymore?*

The training preferred for the machine operators, sawdoctors and mechanics was either short course training at the FITC or preferably in-house training at the sawmills. Roughly two-thirds of the sawmills were ready to train their workers on these training events, if

organized immediately and the costs of the training are moderate. Below are few general comments of the interviewees:

- *"Unfortunately there is no operational training institution in Kenya that offers sawmilling training, so where can we get the adequate training?*
- *We know that all our workers need training but how and where to get it?*

Table 7.11 Type of education or training preferred for the sawmill employees

	Preferred education or training		No		Yes	
		N	Count	%	Count	%
Managers	Formal vocational education	22	19	86.4	3	13.6
	In-house training	22	16	72.7	6	27.3
	Short course training	22	5	22.7	**17**	**77.3**
	Tailor made courses	22	21	95.5	1	4.5
	Apprenticeship training	22	19	86.4	3	13.6
Foremen	Formal vocational education Vocational	22	22	100.0		
	In-house training	22	13	59.1	9	40.9
	Short course training	22	9	40.9	**13**	59.1
	Tailor made courses	21	19	90.5	2	9.5
	Apprenticeship training	21	19	90.5	2	9.5
Supervisors	Formal vocational education Vocational	22	22	100.0		
	In-house training	22	16	72.7	6	27.3
	Short course training	22	11	50.0	**11**	**50.0**
	Tailor made courses	21	19	90.5	2	9.5
	Apprenticeship training	21	20	95.2	1	4.8
Machine operators	Formal vocational education Vocational	22	22	100.0		
	In-house training	22	7	31.8	**15**	**68.2**
	Short course training	22	5	22.7	**17**	**77.3**
	Tailor made courses	21	18	85.7	3	14.3
	Apprenticeship training	21	16	76.2	5	23.8
Sawdoctors	Formal vocational education Vocational	22	20	90.9	2	9.1
	In-house training	22	8	36.4	**14**	**63.6**
	Short course training	22	6	27.3	**16**	**72.7**
	Tailor made courses	21	20	95.2	1	4.8
	Apprenticeship training	21	17	81.0	4	19.0
Mechanics	Formal vocational education Vocational	22	22	100.0		
	In-house training	22	10	45.5	**12**	**54.5**
	Short course training	22	6	27.3	**16**	**72.7**
	Tailor made courses	21	20	95.2	1	4.8
	Apprenticeship training	21	17	81.0	4	19.0
			464		186	

Limiting Factors of the Employment in the Sawmills

The survey respondents were asked about the limiting factor for employment of the new workers at the sawmills. These variables were asked in order to find out whether the workers' competences and lack of technical manpower were limiting the sawmills in expanding their production operations and whether there were some other reasons related to competences and employment of the new workers.

Figure 7.8 shows, that the main limiting factor in over 80.0% of the sawmills was the raw material aspects in various forms. Almost as important as the raw material aspects were the low level of workers' competences (77.3%), lack of technical manpower (72.7%), poor infrastructure (72.7%), inadequate maintenance of machinery (68.2%) and obsolete machinery (63.6%). These results supported the evidence that workers coming from the outside of the sawmill do not have the right competences and generally their professional skills are too low to employ more workers by the sawmills. Another fact was that low level of workers competences does not enable technological development of the sawmilling industry and does not create favorable environment for investments for more advanced machinery, equipment and tools, unless the workers competences and professional skills are improved through proper training and education programs.

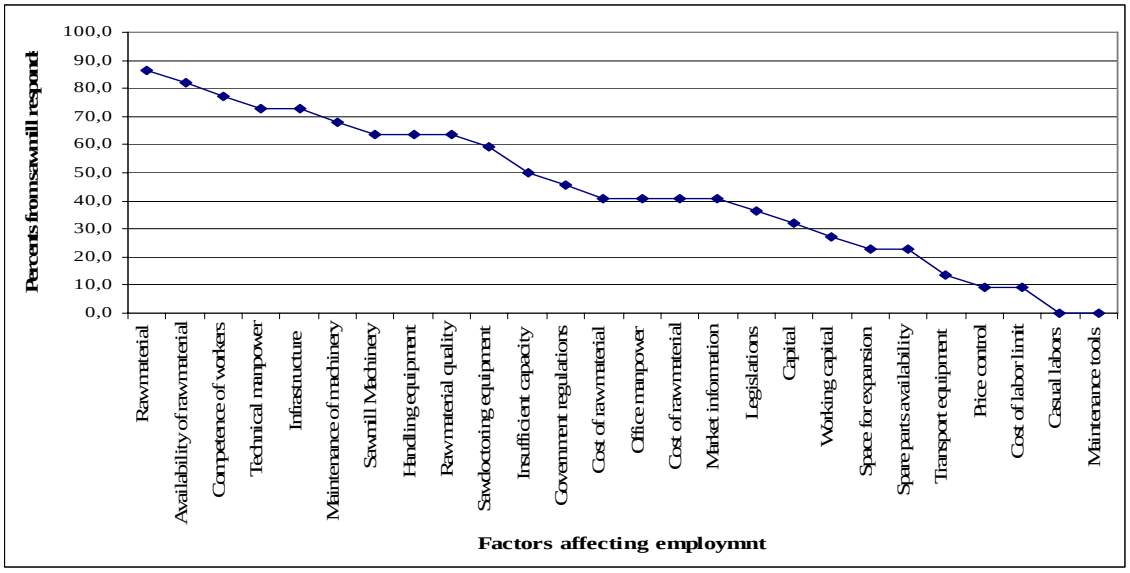


Figure 7.8 Factors limiting employment of new workers in sawmilling

Needs for Technical Assistance at the Sawmills

One work hypothesis of the research was that technical assistance might be needed by the sawmills. This was assumed because Muthike's report already gave indications that the level of workers' professional skills and competences is low. Variables concerning the technical assistance were asked. In these variables the respondents were asked to analyze more about the enterprise's competences and the sawmill's business and managerial capabilities rather than workers' competences and training. This was purposely done in

order to get a better view of the areas to be improved at the enterprise level rather than at the individuals' level. The questions were rated either as of low or high importance.

Table 7.12 shows the results that indicated that the highest needs for technical assistance were in the preparation of the feasibility studies (78.9% of the sample), in sawmilling and wood processing (70.0%) and in production management aspects. These areas were also observed to be the weakest areas of the managers' competences so there was a clear correlation between the lack of managers' competences and the need for technical assistance. Other areas that were inquired about included marketing, wood procurement and product design that were indicated by 30.8% and 33.3% of the sawmills respectively.

Table 7.12 Needs for technical assistance

Need for technical assistance	N	**Low**		**High**	
				Count	%
Preparation of feasibility study	19	4	21.1	Count	%
Wood procurement	13	9	69.2	4	30.8
Sawmilling and wood processing	20	6	30.0	**14**	70.0
Marketing	13	9	69.2	4	30.8
Product design	12	8	66.7	4	33.3
Management	20	5	25.0	**15**	75.0
Training of workers	1			1	100.0
Use of by-products	1	1	100.0		

7.5 Competences and Competence Development Initiatives

Figure 7.9 shows the research results of the workers' competences and indicates the level of the workers' and the enterprises' present competences. It also gives an idea of the development areas if new investments are taking place at the sawmills. Also it demonstrates the availability of a competent labor force to operate the new machinery. A one to five step classification was used to grade the variables, where one corresponded to complete disagreement and five to full agreement with the variable. So if the value was between 2.0-3.0 the result was interpreted that the respondent questioned their competences in that respect, if the value was between 3.0-4.0 the respondent almost agreed with the statement with a little doubt, if it was between 4.1-4.5 the respondent agreed with the statement and if it was above 4.5 the respondent fully agreed with the statement.

The sawmillers agreed that their workers can master (variable 1) the current and simple sawmill technologies that they use today. However, they also agreed that they have had some minor problems (variable 2) to operate their machines. This was evident even though their workers had long experience and they had used the existing machines for a long time. In this respect the problems mainly occurred when the sawmills used little newer and more sophisticated technologies than they had used in the past. Most of the sawmillers agreed with a little doubt that their workers competences to operate the current machines were reasonable good (variable 3). This statement and the workers' abilities and work performance was monitored during the sawmill visits and it was found that the workers' competences were not sufficient, particularly when considering how the effective sawmilling operations and work executions are supposed to be done.

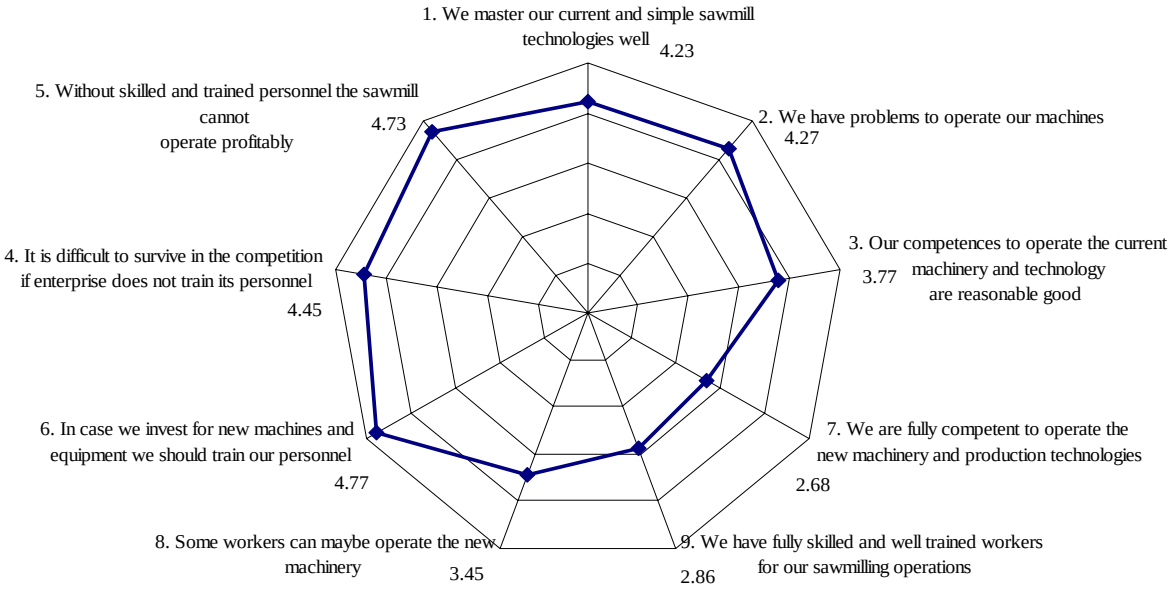


Figure 7.9 Workers competences to operate sawmill machines

The sample sawmills were asked about the correlations between the competitiveness, technological development, competences and training of the personnel. In terms of competitiveness (variable 4) the sawmillers agreed that it is difficult to survive in business without trained personnel and training of the workers. The sample sawmills were even more united in their answers when they were asked about the technological development and new investments in relation to the competences, competence development and training of the personnel (variable 6). The sawmiller fully agreed as the results indicated that, if the

sawmills are making investments in new machinery, equipment or tools, they must train their personnel to operate these new and more sophisticated machinery and technologies.

Another variable that was required in this respect was sawmills profitability versus workers' competences (variable 5). In this respect the sawmillers fully agreed that without professionally skilled and well trained workers the sawmills cannot operate profitably. The survey respondents were also asked about their competences to master new technologies, if invested in (variable 7). As regards to this the sawmillers really questioned about their own and their workers competences and further concluded that if they are going to invest in new machinery and technological development they need sawmilling vocational training and education in all aspects.

The sawmillers were also asked about their current workers' training and professional skills (variable 9). In this respect they seriously questioned first of all their workers' vocational education and training and secondly their abilities and skills for effective sawmilling operations. There were several indications that workers had difficulties even to operate the current simple technologies. The sawmillers were also asked about the new machinery and their workers ability to operate them (variable 8). As regards to this the respondents agreed with many doubts, that only few workers can maybe operate the new machinery. They concluded this that all their workers need to be trained whether they invest in new machinery or they use the existing ones. One director concluded this issue well saying that; "*there must be appropriate sawmilling technologies to suite to our prevailing conditions in Kenya, however we really need training in all aspects to operate the new machinery effectively. Who is going to do all these as there is nobody who cares about us and especially training of our personnel"*.

Individual and Enterprise Competences

The sawmillers were asked whether they had ever defined competences of their workers or the sawmill enterprise in order to develop more firm-specific technological competences and to improve the workers' competences in accordance with the technological development. 31.8% of the sawmillers answered that they had sometimes though about these issues, but they had not done very much to improve or develop the existing situation.

The main reason for this had been mainly the unstable raw material situation and ignorance about the future in the forestry, sawmilling and wood processing sectors as well as lack of appropriate technical assistance, advises and training on the competence development.

Another aspect that was inquired in relation to competences was the respondents' opinion about the importance of defining the enterprise's and the individuals' competences. 85.7% of the sawmills agreed that it is important to define them in order to improve their performance. When the sawmills were further asked whether they have the capacities to define the competences, only 18.2% of the sawmillers answered that they are able to do it.

The sawmill managers were also asked to compare whether their sawmill has better individual and firm competences than their competitors in the surrounding areas. Obviously the answer was "yes". 68.2% of the sawmills classified them to be better than their neighbors and competitors. Researchers monitored this during the mill visits and they had a mutual understanding that all the sawmills seemed to be more or less equal in terms of their competences. When further inquires were made as in which areas they were better, they reported that in sawn timber processing (40.9%) and in sawdoctoring (22.1%). This was totally in contradiction with the observations made by the interviewers, who found that sawdoctoring was one of the weakest areas, although it is the most important area of the sawmilling operations. One sawmill supervisor responded to this as follows; *"we have never been taught anything like this, we are not able to do it and therefore we need the external technical assistance to do all these things and also development of our sawmills"*.

Table 7.13 Analysis of the sawmill competence areas

Subject area	**Sub-areas that were strong or needs some extra attention**		
	Can be handled well	Needs special attention	To be developed first
	Count	Count	Count
S/Doctoring	**6**	**4**	**4**
Designing			2
Sawmilling	**5**	**2**	**1**
Production skills	**5**	**4**	**3**
Transportation		1	
Logging		2	3
Joinery	1		
Machine maintenance	**1**	**4**	**3**
Raw material procurement			1
Supervision		3	1
Management	**3**	**1**	**3**
Marketing	1	1	1
N	22	22	22

Table 7.13 shows the competence areas of the sawmills that were strong and the areas the sawmills were able to master. It also indicates the areas that need to be developed. The results indicated that the strongest areas were sawdoctoring, sawmilling, production skills and management, which were also indicated to be the most important areas to be developed. This shows that there were some contradictions between the respondents' answers. The competence development areas that were rated important were sawdoctoring (36.3% of the sawmills required), sawmilling and sawmill production skills (45.5%), machine maintenance (31.8%) and management (18.2%).

The sawmills were also asked about different learning environments. These questions covered and asked for opinions about the learning environment in connection with the enterprise's atmosphere, attitude for learning, abilities to organize learning situations and capacities to establish competence development. Table 7.14 shows the results.

Table 7.14 Learning aspects of the sawmills

Individual and enterprise learning	N	**No**		**Yes**	
		Count	%	Count	%
Enterprise has favorable atmosphere for learning	22	1	4.5	21	**95.5**
Enterprise was open for learning and development of human resources	22	1	4.5	21	**95.5**
Owners and managers knew that management of learning process is a demanding task	22	3	13.6	19	**86.4**
Enterprise was ready to support individuals' learning process	22	4	18.2	18	**81.8**
Enterprise knew who needs training, how much and why	22	7	31.8	15	**68.2**
Enterprise has the capacity to estimate present competencies	22	15	**68.2**	7	31.8
Enterprise understood about the concept of learning organization	22	17	**77.3**	5	22.7
Owners and managers knew how to organize human resources development	22	17	**77.3**	5	22.7
Enterprise knew what competencies are required in effective sawmilling operations	22	17	**77.3**	5	22.7
Enterprise is able to facilitate learning processes in practice	22	18	**81.8**	4	18.2

The encouraging result was that as much as 95.5% of the sawmills reported having a favorable atmosphere for learning and they were open for learning and human resources development. 86.4% of the sawmill owners and managers understood that management of the learning processes is a challenging and demanding task that must be well planned and established. 81.8% of the sawmills were ready to support individuals' learning, as long as there is proper training available and the training programs are planned by considering the sawmill requirements, and that the sawmillers and all the sawmill stakeholder groups are involved in planning, establishment and implementation of the training programs.

8 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

The studies carried out under the KFS have highlighted the serious and numerous problems that the sawmills have faced in Kenya. They have not had enough raw material or professionally educated and trained workers. Because of these exceptional conditions the sawmills have not been interested in developing and investing in their production operations, technological development or competence development. (MMMB 2008, 13.)

The theoretical framework of this research was built around the perspectives of the workers' occupational competences, professional skills and work qualifications. These aspects were studied and considered from the Kenyan sawmilling industry and the sawmills' point of views. The aim of the research was to produce new knowledge and information on sawmills' capacity building and competence development for assisting the Kenyan sawmills in their development. This was found to be important because the number of sawmills has reduced rapidly and the production capacity of the operational ones has diminished, causing a shortage of sawn timber in Kenya. Amongst the other reasons, the closure of the FITC has been significant. As a consequence of this the sawmill workers' competences and professional skills have reduced considerably. This has caused a lack of qualified workers leading to low raw material recovery and poor sawmill viability.

8.1 Discussions

Many developing countries, including Kenya, do not possess a large amount of patent-protected technology upon which they can build new technologies of an industry, such as the sawmilling industry. If the sawmilling industry in Kenya wants to become more efficient and productive, sawmills need to invest in more modern and appropriate sawmilling technologies; supported by the comprehensive human resources development.

Sawmill Technologies and Technological Development

When speaking about capacity building, we often mean the physical resources like investments, technological development, tools, machinery, techniques and working methods. However this is only a one part of capacity building. Another part is the

competence development of people and organizations, in which we need to consider the workers' knowledge, skills and their abilities as well as the organizational capabilities.

The sawmilling industry in Kenya was a good example of an industry showing initiative and ingenuity under adverse conditions. The sawmills had various problems in sawmill design and layout, set-up of the machinery and machine operations. This was particularly the case in the SMS sawmills. These problems have caused longer processing times, lower productivity and smaller production volumes. The problems were not caused because of the simple and obsolete machinery in use but because of the lack of worker's knowledge, professional skills, competence and experience in sawmilling.

Technology itself is a combination of physical equipment and techniques, combined with worker's knowledge and competences to assemble, operate and maintain the machinery. In technological transfer there must be certain formal procedures that are followed, especially when appropriate technologies and their operational features are to be transferred to developing countries. (Karani 2001, 230.) Technology transfer to developing countries is a complex issue. In effective and sustainable technology transfer we need to have competent personnel, good technical know-how and appropriate technologies to local conditions.

The research results indicated that the sawmill owners and managers did not have adequate information or knowledge about the appropriate sawmilling technologies. On the other hand the owners said that they are interested to invest in technologies as long as they are aware of what type of machinery and equipment are advisable. Currently very basic processing and sawmilling technologies were used for converting raw materials into sawn timber. The sawmills were operating with extremely obsolete machinery. The existing, old and obsolete sawmill machines were partly appropriate, especially when considering the prevailing conditions and the workers' existing professional skills and competences. Despite their appropriateness, these machines are low in productivity, unsafe and in poor working condition. They are not maintained and serviced, only repaired.

Whatever the structure of the industry and the machinery is, the used machines could always be modified and developed to be safer, more productive and more economical. The difficulty in this development is the lack of knowledge and competence in designing and

manufacturing of the sawmill machinery as well as the lack of technological know-how in appropriate sawmilling technologies. The positive side of this absence is that these abilities and competences can be developed trough appropriate training and technical assistance.

Technology development plays also an important role in the enterprise's and workers' competence development (Drejer & Riis 1999, 632). Therefore, when introducing new sawmilling technologies to Kenya the development of the sawmill workers' competences should be carried out at the same time. Technological development, technology transfer and competence development go hand-in-hand, so if there is technological development there must also be development of know-how, professional skills and competences.

The following aspects showed that the sawmill workers, supervisors and managers in the Kenyan sawmilling industry did not have adequate know-how, professional skills and occupational competences in sawmilling and that there was a lack of training in sawmilling:

- The preparation and handling of logs, sawn timber and the final wood products were inappropriately and inefficiently executed causing low product qualities.
- Log and timber yard arrangements were not well planned and organized.
- Sawn timber drying either by kiln drying or seasoning was not carried out at all.
- Sawmills were not well arranged and the production flow was inefficient causing extra work, extra handling and excessive safety and fire hazards.
- Poor machine maintenance caused many production and machine breakdowns, extra expenses, accidents and longer processing times.
- Housekeeping and cleaning of the sawmills was extremely poor, causing extra safety and fire hazards and problems in material handling.
- Dirty, sandy and poor quality logs and sawn timber caused a lot of damages to saw blades and planer knives, leading to excessive saw blade maintenance and therefore extra production costs and poor quality final products.

The sawmill managers and owners understood and recognized the concepts of technological versus competence development, however they questioned the situation with training institutions and the availability of sawmilling training in Kenya. They further questioned who will assist the sawmillers in technological development and who will organize training activities, since the KFS has not been able to do it, even though they have

had the excellent training facilities. The sawmillers agreed that the introduction of more advanced and more appropriate sawmilling technologies and technology transfer are important issues. They highlighted that it is not advisable to introduce and bring the latest sawmilling technologies immediately because there is a lack of competent labor.

Inadequate know-how of sawmill machinery techniques and no understanding of the preventive maintenance, together with the low level of workers' professional skills and competences in maintenance were the reasons for the condition of machines. Even the best machinery cannot be operated efficiently without correctly maintained saw blades. Sawdoctoring is the backbone of efficient and successful sawing operations. Well executed sawdoctoring is the best preventive maintenance. None of the sawmills had understood these basic principles and none had applied proper sawdoctoring operations. Saw blades were used for too long periods without any maintenance and therefore the sawmill productivity was low and the quality of sawn timber was poor. Sawdoctoring and machine maintenance were the weakest areas. Most of the sawmills need to pay immediate attention to these. The best assistances in this respect could be on-the-job training, extension services and technical assistance at the sawmills.

Use and maintenance of circular saw blades was said to be the easiest and most convenient sawmilling technologies for the sawmills. This was monitored not to be the truth. The sawmills used extra-thick and the wrong type of circular saw blades, leading to very low raw material recoveries. The sawmillers did not see this problems. They were satisfied with their sawdoctoring work and the quality of saw blade maintenance, although at the same time they complained about the poor economic results of the sawmill. This "wrong approach" increased their problems and lowered the economic viability of the sawmills.

The sawmilling industry in Kenya was old and still very little developed as compared to other Eastern and Southern African countries, from where the researcher has several years work experiences and where he has earlier worked and carried out the similar studies. One reason for the low sawmilling development has definitely been the long lasting logging ban. Another reasons could be the low availability of sawmilling training and low level of workers' professional skills and competences working in the sawmills today.

Sawmill Production and Its Limitations

Kenyan sawmills have a low level of technological development, undeveloped production methods and outdated working procedures. These have been the consequence of non-competent workers and untrained labor in the sawmilling industry, which also has led to extremely low raw material recovery of 23 - 46%. (MMMB 2008, 13.) The recoveries were calculated in this research, too. The achieved results were the same as the MMMB project indicated and Wamukoya and Muthike reported in 2007 and in 2006 respectively. The low recovery was mainly caused because of the following reasons:

- Wrong selected and too thick saw blades being used for cutting.
- Incorrect cutting methods used for cutting of logs and cants.
- Poor saw blade maintenance and setting of the machinery.
- Untrained and incompetent operators, workers and managers.

The raw material recovery was calculated and in some sawmills it was as low as 23%, which is not acceptable by any sawmilling standard or indicator. It was monitored that volumes of waste, sawdust, slabs and off-cuts were extremely high, although a few sawmillers said happily that their sawn timber recovery was 70-80%. These figures are unrealistic in normal sawmilling operations. The research results indicated also that not many sawmillers calculated the raw material recoveries. The results of this research were exactly the same as Muthike reported in his study of 2006. The most common sawing method was the quarter sawing method. Although, this was the most common, it was seen that the machine operators did not know the principles of economical sawing and therefore they were not able to recover the raw material efficiently. Photos and examples of poor recovery are shown in the Appendix 4 photos of 9 and 10.

Product variation was also monitored to be one of the problems. This indicated that the sawmillers were not aware of the principle of adding value to sawn timber, maybe because of low professional education and lack of awareness for adding value and improvement of the product qualities for better market value and the viability of the sawmill.

In sawn timber processing the competence of workers and managers can be monitored from the mechanical quality of sawn timber, surface quality, appearance and dimensional

accuracy of the final products. These features can only be good when saw blade maintenance is correctly executed, machines are well maintained and adjusted, the raw material requirements are followed and workers are well trained. During the sawmill visits sawn timber dimensions were measured and controlled by the researcher. The results indicated that accuracy of the dimensions was very poor. The sawmills reported that they do not measure the sawn timber dimensions or control the accuracy, the appearance or the quality of sawn timber. The reasons were told to be as follows:

1. Customers accepted any sawn timber, with any qualities or dimensions.
2. Everything, even the lowest quality sawn timber was sold due to high demand.
3. Sawmillers, dealers and customers had a poor attitude and appreciation about the sawn timber quality.

These are all indications of low attitude, poor professionalism and low level of education and training of customers and the sawmillers and their workers. One notable observation was also that sawmills did not utilize residues, like bark, sawdust or chips for any commercial or value-added purposes or even for simple power production.

The results indicated that very few sawmills dried sawn timber and only one sawmill used artificial kiln drying. This is again an indication of lack of training. If the consequences, of not drying sawn timber are considered and calculations made to find out the economic consequences, for instance in the extra expenses and costs occurring such as in transportation and lower product qualities versus values of sawn timber, this could be called national economic devastation. For instance the transportation of wet sawn timber will increase the total weight transported easily by 30-40%, but how much it will increase the extra costs and expenses occurring, if for example expenses of truck tires, repairs, maintenance, fuel and other costs are considered. This describes that the level of knowledge, professional skills and competences, both within the wood industry personnel and the stakeholder groups were low. Examples of timber drying practices are shown in the Appendix 4 photos of 7-8.

Poor sawn timber grading or no grading at all caused various problems in sawmilling such as lower qualities, lower and more difficult pricing and less profit. The main reasons for not grading were low customer appreciation, lack of grading standards and unavailability

of sawn timber specifications. The reasons for low quality were the lack of know-how and awareness about sorting and grading benefits, and their effect on the business result. Other aspects were the low customers' demand of higher qualities, the high demand for sawn timber and unavailability of wood products. The final quality of the sawn timber and other wood products was poor, mainly due to improper materials handling in the sawmill yards. Another reason was obviously that wet sawn timber was machined, leading to poor surface quality, waste of resources and extra, unnecessary expenses. Examples of these are shown in the Appendix 4 photos 3-4.

As explained adding value to sawn timber was very rare. The owners and managers said that they were not aware of value adding and they did not understand the concept clearly, because they had never been taught about it. They said that they don't have information about the further processing opportunities, machinery and the benefits they would achieved. Further processing and planing of sawn timber was only done in order to improve the sawn timber surface appearance, dimensional accuracy and to keep customers happy, not to add value for sawn timber and income for the sawmill. These activities were done because the sawn timber surface was too rough and the dimensions were not accurate. The causes for these were the low operators' professional skills and competences in sawmilling operations, poor setting and maintenance of the machines and poor maintenance of the saw blades. Because of these quality problems the sawmills needed to upgrade their sawn timber by planing it. This was not adding value, but it was just an extra service for the customers, which caused extra loss of raw material and extra cost for the sawmill. Sawmillers did not consider this as a deduction of the recovery or extra cost. It was done because the customers required it and the sawn timber dimensions did not meet the customers' requirements.

Planing and molding of sawn timber was made in 90% of the sawmills, but worst of all, it was wrongly executed. The sawn timber that was molded was wet and not seasoned or kiln dried. These unnecessary activities reduced the raw material recovery, the profitability of the operations and the viability of the sawmill. Consequences for these were poor know-how and attitude of the sawmillers in production operations and customers' poor appreciation of higher product qualities. One cause was also the high demand for wood products, which did not encourage sawmillers to think about drying and value adding.

Record keeping and reporting of production inputs and outputs are important instruments for sawmill management to follow-up the sawmill's production operations and to execute the necessary corrective activities. Also, they are essential for the government and income taxation offices to follow-up the sawmill operations, taxation, raw material consumption and utilization of the natural resources in general. Without appropriate record keeping and reporting system this is impossible. There were several indications and evidence that sawmill record keeping was totally neglected. This was confirmed when the production figures were queried from the sawmillers. The managers gave their production information without any supporting documents such as accounts, record books or reports. In most sawmills the record keeping was completely deficient. Areas of deficiency included record keeping consciousness, non-existence of the system itself, the adequacy of records and above all poor up-to-date record keeping procedures. Record keeping was not done accurately and not according to required procedures for reporting.

These sawmill record keeping aspects among the many other aspects indicated that the sawmill enterprise management and the sawmill production management procedures were not effectively executed or at least they were not executed as required in properly managed sawmill. Theses results indicated also the low level of owners', managers' and supervisors' know-how and competence in sawmilling. On too many occasions the managers were just guessing their answers and wondering what is going on in the operations rather than basing their statements on the real records and reports.

These areas that need of immediate attention included planning, record keeping, costing, cost accounting, budgeting and quality control. These are the technical and managerial abilities that are required from the professional sawmill manager. Most of the sawmillers did not have this management knowledge, abilities and competences. Because of these weaknesses many sawmills operated without any business or strategic plans, which led to haphazard operations and management by crisis instead of by objectives. Because of these machinery, raw materials, personnel and capital of the sawmills were all under-utilized.

The discussion above has clearly indicated that the sawmill workers did not have the required knowledge, professional skills and competences for their occupations. One problem for sure has been the lack of formal education and training, and the closure of the FITC.

Education and Training

Over the past decade most countries have experienced a significant increase in external dynamics and therefore they have been forced to develop their workers' and enterprises' competences. Kenya and its sawmilling industry have not been an exception to this, although the development of sawmilling has been slower than other industries. The sawmilling sector in Kenya is generally underdeveloped and inefficient. This is due to a number of factors. One of them is a lack of competent and qualified personnel, which leads to low labor productivity, poor wood product qualities and low sawmill productivity. In order to respond to this there is a need to look for improvement and development of the workers' competences and occupational qualifications through improved vocational education and adults further education and training. The KFS, TMA, KFC and FITC should react immediately to this challenge together with the sawmillers.

The research results indicted that sawmill workers have low professional education as only 16.0% of the personnel had some kind education or training. From this amount 8.1% had short-course training, given mostly by the FITC, and only 7.9% had higher than certificate level professional education. Remarkable fact was that less than half of the sawmill managers had professional education, however their professional education was better than the sawmill workers'. Two-thirds of the managers did not have any professional education for management of a sawmill. Therefore, it was not surprising that the state of the sawmills was so poor, technological development low, the working methods inefficient, sawmill arrangements unproductive and production management procedures not in order.

The sawmill owners and managers held a consensus that competitiveness of the sawmills and the viability of the business are directly linked to technological development, investments and to the workers competences to operate and maintain the machinery. In addition these are directly linked to the level of education and training of the personnel and to the existence of adequate training institutions with a sufficient curriculum. In this respect all agreed that vocational education and training in sawmilling are a must if the Kenyan sawmills would like to succeed in their mission and would like to develop their operations progressively by considering both technological and competence development.

It was found through the research that the sawmillers did not require any professional education or training from their workers. This was due to the fact that the workers were somehow able to operate the existing machinery. However, what would be the situation if new sawmill technologies and machinery would be introduced? In answers to this question there was a consensus that all the stakeholders must participate in the establishment of competence development programs and all the sawmill employees must develop their competences in the operations, maintenance and use of the machinery.

Generally, the level of workers' formal education was excellent, but the situation in professional education was alarmingly low. The only exceptions were the carpenters, accountants and electricians who had a better professional education than the others. 75.0% of the carpenters, 85.7% of the accountants and 100.0% of the electricians had a professional education. These high percentages illustrate how high the respect is for carpenters and when the national standards and legislation require certain professional education and competences for a certain occupation, the requirements are in place and people have the required professional education and qualification. This should also be the case in the Kenyan sawmilling industry. Therefore, clear regulations and standards for sawmill workers' occupations, their competences and qualifications should be defined. The sawmills should be required to follow these regulations, and they should be further required to train their personnel. Sawmills should only be allowed to qualify for sawmilling operations if they participate in workers' competence development, at least to a certain extend of training of the key personnel. In this way the effectiveness and productivity of the sawmills can be improved and the competences of the workers and the enterprises developed. In Kenya there are no specific requirements for sawmill workers' occupational competences. Therefore, they should be identified and defined in order to facilitate the establishment of formal vocational education and adult further training programs in sawmilling.

Although the sawmill workers' formal education was excellent it cannot alone facilitate effective sawmilling operations. A good formal education provides a firm basis for formal vocational education and for vocational adult education and further training. Now, appropriate training curricula are needed for both formal vocational education and adults'

vocational education and further training in sawmilling. Also, development of teaching models and methods to teach the contextual-based training are needed.

The results of this research indicated that sawmillers have high expectations and appreciation for vocational education and further training. They have been really interested in the workers' competence development and training in sawmilling, although now they had their doubts about the KFS establishing the training opportunities and they were suspicions about the capabilities of the KFC and FITC to plan and implement the training programs in sawmilling. Their assumption was based on the fact that FITC has already been closed down about ten years ago. Therefore, their expectations about rehabilitating and re-opening of the FITC and to begin its training activities again were suspicious.

Today, the global changes and industrial developments are faster than ever. The forestry and sawmilling sectors are no exception, in Kenya or anywhere else. Nations that are traditionally strong in manufacturing of old fashioned forest and wood products are now experiencing remarkable changes in their industry, technology, machinery, work and work organization as well as in structures of vocational education and further training. This research indicated that this is the situation also in the Kenyan sawmilling industry. As part of the competence development process the workers' competence must also be improved. Therefore, new methods and approaches for training and technical assistance in sawmilling are needed. Because of the significant technological changes, up-dating of the sawmill workers' occupational profiles, and identification of their qualifications are also required in order to establish adequate sawmilling vocational education and training curricula.

Many changes are seen in Kenya that affect sawmills' work and competence development. These changes should be accepted by the working society, government and the training institutions in order to respond to these challenges. Currently all work in the Kenyan sawmills have been done by the people who have relatively good formal education, but very low professional education or training. Because of this, the sawmills suffer in their production operations. In these circumstances it is important that the workers' Knowledge, professional skills and occupational competences are updated. Everybody, the KFS, the training institutions and the sawmills and their workers need to face the challenge of self-development and lifelong learning, both at the individual and enterprise level.

Competences versus Competence Development

Competence development begins from the enterprise's existing situation, vision and business objectives. In Kenyan sawmills these business fundamentals were not in good order. Most of the sawmills did not have any strategic or business plans upon which they based their operations. Many of them operated just by feeling and not by planning in advance. If production operations, technologies, working methods or processes change there is always a need for learning, and there is also a need for people to learn and facilitate the changing process. This is also the situation in the Kenyan sawmilling industry. The research indicated that the Kenyan sawmills and their workers competences were not highly developed and therefore the sawmills must go through a total change of their operational environment. This will only happen, if they are allowed to do so and they are supported by the Kenyan government and the KFS with facilitation of more open and more sustainably established business environment. This process will directly assist sawmills' technological development, workers competence development and soon also the education organizers. Therefore, the sawmills, the KFS and particularly the training institutions must be prepared for this challenges.

This research pointed out that the limiting factor for more employment in sawmilling was the lack of workers' competences and professional skills, which also limited sawmills' technological development and investments. The situation cannot be improved unless workers' competences are developed and improved. The sawmill managers and owners admitted that without competent and trained personnel their sawmills cannot operate economically and viably. The results indicated that there was a high correlation between the sawmills' technological development and lack of workers' competences and training, which affected the productivity, effectiveness, profitability and viability of the sawmills.

Ellström (1997) stated that formal competence refers to the educational or training competence without great practical work experience whereas the occupational competence refers to the situation that can be fully handled by the individual. The biggest difference in that respect is that occupational competence includes the outcomes and the everyday activities of work that cannot be learnt only through education. For that reason the occupational competences are defined according to the job and working society

requirements. (Ellström 1997, 268.) This is actually what should be done in the Kenyan sawmills today. First occupational profiles with the job requirements should be identified and defined for each sawmilling occupation and secondly a curriculum for adult education and further training in sawmilling should be established in accordance to these.

This research indicated that workers' abilities to operate the new technologies are not sufficient and that there is a big need for training in this respect. In actual fact, the respondents rated their workers' competences to higher level than they actually were. This happened, because the respondents did not know exactly the level of new machinery and therefore, they were not able to analyze whether their operators are able to operate the new machinery or not.

In terms of availability of the qualified sawmill workers', the respondents informed that they do not know whether they exist or not. It can be assumed that if the trained sawmill workers were not currently working at the sawmills they would not exist anywhere else in the country. This is because there has not been any sawmilling training for about ten years. The results indicated that the biggest need for improvement, development and training are in the areas of sawdoctoring, sawmill machine operations, machine maintenance, in introduction of production methods and processes, and in sawmill production management.

Generally, all the sawmills had a favorable atmosphere and positive attitude towards training, competence development and capacity building of the personnel. The sawmillers were very favorable to any training offered. However, they highlighted that good supporting instruments, efficient and simple development methods and models and qualified people must be available for both training and technical assistance. The majority of the respondents admitted that enterprise competence management and development as well as competence development and teaching of individuals are demanding tasks that must be well planned and established. Therefore, they concluded that there is a need for special assistance and support to plan these development tasks at the sawmills.

Discussions with various stakeholder group representatives confirmed that there was not enough competent sawmill workers in Kenya. The sawmillers expressed that the sawmills' competence development and capacity building cannot be solved only in the ministries or

at the KFS offices. They said that there is a need to establish a joint board to administer the competence development processes. All stakeholder groups must be represented on this board, including KFS, KFC, FITC, KEFRI, financiers, customers, dealers and of course the sawmills. These boards, forums and development work should be started now and not when the forest plantation resources have been made available. Openness in interactions and communications must be maintained at all the times and through out the process.

Technical assistance in sawmilling was also discussed with the sawmill representatives. The main conclusion in this respect was that there is a big need for direct technical assistance to the sawmills. This should include advice on machine manufacturing and modifications, machine maintenance, sawdoctoring, production control, record keeping, production management and business management of an enterprise. Also, there is a need to support the sawmillers to prepare feasibility studies, budgets and business and strategic plans. These areas were actual fact indicated as the weakest areas of the managers', so there is a clear correlation between the lack of managers' competences and the need for technical assistance. These technical assistance services can be established in various forms and approaches depending on the needs of the sawmills.

Generally, it was observed that the current institutional linkages between the forestry research and education and sawmills' management, administration and owners and private forest owners were weak. In particular, forestry research and education institutions such as KFC and FITC should be more active, demand-driven and facilitated to go out to the field. It is a big challenge to ensure competent personnel, especially when there is a heavy structural change in technologies, operations and in human resources, as it is going to be in the Kenyan sawmilling industry. Without doubt one solution is co-operation and networking between the sawmills and the training institutions. Through well-organized co-operation and well established programs the objectives can be met in the short and long terms. Through co-operation and networking, the sawmills can more effectively contribute their ideas and needs to the training organizers in order to assist them in planning and establishing more appropriate competence development models and training programs.

This research indicated that there was no co-operation and networking between the sawmills, training institutions or between the TMA and the KFS. The challenges in

sawmill workers' competence development are, first of all, how the sawmill enterprises can determine their workers' occupational profiles, secondly how they can analyze the competences required in each occupation and finally how the training institutions and the government institutions use this information for the development of relevant education and training programs and competence development and capacity building programs. Definitely, the sawmills need professionally qualified and well trained people. This is a challenge for all, the KFS, KFC, FITC and the sawmills. The preparations should begin immediately, not tomorrow, action should be taken and results should be shown soon.

8.2 Reliability and Validity of the Research

When carrying out research, mistakes are avoided as much as possible; although it is often not possible due to the unpredictable and difficult research circumstances or situations. Sometimes interviewees are not aware of the subject matter that the researcher is asking about or they do not have the required and adequate experience from the field to facilitate the best possible contribution. Mistakes might sometimes occur because of a wrongly established research approach, questionnaire or even individual questions. Therefore, when carrying out research we must always monitor and estimate reliability and validity aspects.

Reliability

Reliability means the consistency of measures, or the stability to re-administer the research with as small a variation of results as possible (Bryman & Bell 2007, 163). In this research the interviews were carried out by two researchers, which improved the reliability. The survey answers and results that were produced had evident similarities, so the reliability in this sense was also proven to be sufficient.

The reliability was also improved through the face-to-face interview approach, which provided corrective actions concurrently with the interviews. This was done in order to ensure clear understanding of the questions as well as to improve the quality of the answers. Carrying out the interviews and filling in the questionnaire also simultaneously ensured that selected persons and sawmills were involved in the interviews and the field survey, which both improved the reliability.

The representation of the sawmills in the research was the same as their actual existence within the Kenyan sawmill population. This selection was purposely done in order to maintain the statistical reliability and to enable generalization of the results. The final reliability depends on the conclusion to be drawn about the population and whether the sample correctly represented the whole sawmill population.

Validity

Another definition that is used for examination of the research is the validity, which means how efficiently and effectively the research and its established indicators measure the aspects and issues that they were supposed to measure. Validity of the research can be measured either from the methodology, the structure or the predictability points of view. (Hirsjärvi et al. 2005, 216-217.)

One difficulty in this research was the fact that no advance information was available about the sawmilling industry in Kenya and especially the competence studies executed earlier in Kenya. Another aspect that affected the validity was the fact that training institutions who have arranged sawmilling training in Kenya have not been operational for a long time. Therefore, there was no up-to-date information about the workers' competences, their development or any training needs previously analyzed. However, valuable feedback on these matters was received through this research.

The validity of the research was improved remarkably by the selection of the appropriate research strategy, methods and approaches that suited the conditions prevailing in Kenya. Oral interaction and conversation between the interviewer and interviewees was therefore emphasized so as to provide a good understanding of the research questions and to provide an opportunity to make personal observations, which all improved the validity of the research. Improvement of the reliability and validity was expected when the triangulation research methodology was selected, with simultaneous oral interviews and the pre-structured survey questionnaires.

8.3 Conclusions

Today, the world is in a significant recession. It affects both developed and developing countries, their industries and society. Individuals are experiencing changes in their working environment, employment and work. This often requires self-development and re-education by updating ones' knowledge, skills and competences. In many industrial sectors there are big structural changes going on both in the developed and developing countries. Kenya and its sawmilling industry are also in transition and development phases.

The starting point for the research was the given assumption that the sawmilling industry in Kenya is in a stronger recession and changing environment than other industrial sectors in Kenya. During the last ten years the sawmills have had problems in their raw material supply, which has caused closure of hundreds of sawmills. Consequently the technological development of the sawmills has been at a minimum and the number of working places in sawmilling has reduced dramatically. In addition to this the closure of the FITC has affected the training of the sawmill workers. As a consequence, the sawmill workers' competences are lower than ever. Therefore, the workers productivity is lower than before and the sawmills' effectiveness and viability are worse than for years.

The Kenyan forest sector is presently going through a reform that should facilitate better operational conditions for both the forestry and wood processing sectors. Through this, the sawmills are expected to be authorized with new licenses to restart their operations. Because of the constraints, it was necessary to study the workers' and sawmills' situations and to analyze their competences and the training and competence development needs.

Through this research it was found that the sawmilling technologies and workers' competences in Kenya have not been developed since the forest ban was announced in 1999. The sawmills that operate today are still operating at the same level, with the same people and with the same competences that they operated some 20-30 years ago. It was also found that many sawmills lack proper development plans, long-term competence and skills development schemes and proper planning, management and reporting procedures.

In this research the information about the sawmills and their potential to invest in competence development were studied. In this respect it can be concluded that the technological level of the sawmills was low and backwards. If better effectiveness of the sawmills is to be achieved, the sawmills need to be rehabilitated and their technologies, sawmill designs, production operations and procedures, material handling, maintenance and production management and control should be strengthened. This research indicated that the sawmill owners are interested in investing as long as the correct supporting activities and technical assistance are put in place to support them in the selection of the technologies and in the development of the production operations.

From the technological development point of view it can be concluded that whenever there is a change of technology there is technological transfer and there is development. All in all, there must also be competence development of both the individuals and enterprises. This will also be the situation in the development of the Kenyan sawmilling industry and its personnel. Over 90% of the sawmills are willing to expand their business and are ready to employ more people, if the workers are competent and qualified and if adequate competence development and vocational education and training programs are available.

Other important findings and results were that the raw material utilization and recovery were poor and the sawmill techniques, processes and cutting methods used at the sawmills were not efficient. The raw material issues are important for the sustainable use of the natural resources. The results in this respect were frightening and provocative, showing that only an average of 35% was recovered, when normally the recovery is nearly 50% or even more. The sawmills produced only sawn timber. The by-products like slabs and off-cuts were not utilized or further processed for any commercial purposes. Few reasons for these were that technologies, production processes and working methods were wrongly selected and inappropriate, leading to low raw material recovery, poor product qualities, low productivity of the operations and eventually poor viability of the business as a whole.

Formal education in Kenya is generally good and it gives a good basis for vocational adult education and further training. The sawmill workers had long working experience but hardly no vocational education or training. Only about 16% of the sawmill workers had some kind of professional education or training. Furthermore, currently they did not even

have opportunities for further training to upgrade their professional skills and competences. This was because of the closure of the FITC in Nakuru.

In order to improve and develop this situation, various theories, research and literature from adult education, learning at work and competence development were reviewed and analyzed. It was found that Knowles's theory of Andragogy for adult education was the best theory and approach to teach experienced adults in vocational education and training whereas the theories and definitions of Hanhinen and Ellström were found to be the most adequate to identify and define the terms of occupational competence and a related qualification as well as other terms related to occupational development.

The research results answered the set research problems well and the recommendation gave efficient solutions for the implementation. However, it can be concluded that in terms of the research methodology and approach there could have been some other more effective solutions. In particular, this applies to the structure and size of the field survey questionnaire, which could have been structured still in more detailed thematic format and with better structural contents. The questionnaire could have been shorter and more precise leading to more accurate results and findings as well as easier analyses. Also, the rating system of the questions could have been the same in all questions so as to provide a more effective comparison of the research dimensions and to achieve more illustrative construction of the measurable and descriptive indicators for the research results.

In all, the research results provided a broad and valuable basis for the theoretical and practical recommendations, which will enable development of the Kenyan sawmilling industry in general, and in particular the development of the competences of the individual sawmill workers and the sawmill enterprises. The research provided valuable information about the new researches that could be implemented to support the development and strengthening of the sawmills and the sawmilling industry in Kenya as a whole.

8.4 Recommendations

Competence development is a long-term, comprehensive and progressively building process that combines technological and competence development together with vocational

education and training. The process must be participatory, established and integrated with all stakeholder groups. The process is a value chain that requires efficient and effective co-operation, networking and good coordination of the activities and operations. In order to succeed in this mission everybody's full commitment is required, often supported with internal and external assistance. The key players associated in this particular case are the KFS, KFC, FITC, development projects, and the individual sawmills and their workers.

The following recommendations are proposed in order to improve the existing sawmilling industry situation in Kenya and to develop the individual sawmills with their problems and difficulties, which mainly were the workers' competences, sawmills' technological development, recovery of raw materials, low productivity and poor viability of the sawmills. These recommendations have two main components under which various sub-recommendations and activities are suggested. Through these the "hard competences" (= technologies) and the "soft competences" (= human resources) of the sawmills can be developed mutually to achieve both the short and long term objectives. The recommendations have been established in accordance with the achieved results and their analyses supported with researcher's personal experiences, observations, views and opinions that have been gained through long term work experiences in developing countries, in particularly in Eastern and Southern Africa.

1. ***Planning and establishment of a comprehensive sawmill enterprises' competence development scheme***
    a. Strengthening and re-establishment of interaction, communication and co-operation between the sawmills, TMA, KFS and the forestry and sawmilling training institutions.
    b. Establishment of networking and sawmills' twinning arrangements to provide exchange of experiences, information and knowledge.
    c. Establishment of a technical assistance programs to assist sawmills in their technological, managerial and competence development.
    d. Scanning and categorizing of learning at work, on-the-job training and apprenticeship training for the sawmills.
    e. Establishment of three provincial pilot sawmills in each of the three main forest provinces for the use of training, demonstrations and examples.

f. Introduction of the information and promotion campaigns on training, technical assistance and competence development to improve and increase the awareness of the sawmills and their stakeholder groups.

2. Establishment of vocational adult and continuing education programs, training curriculum and competence development of the sawmill workers

a. Merging the FITC with the KFC to re-start vocational adult education and training in sawmilling as well as to support the KFC training curricula.
b. Re-opening, rehabilitating and strengthening of the FITC training facilities in Nakuru to continue practical training in sawmilling.
c. Defining and describing the sawmill workers occupational profiles and their qualifications in order to assist FITC and KFC in their curriculum development for sawmilling training.
d. Revising and preparing the sawmilling training curriculum for vocational adult education at the KFC and FITC premises.
e. Re-starting the practical sawmilling training, technical assistance and sawmilling extension services at the FITC and the participating sawmills.
f. Establishment of a comprehensive vocational education program for sawmill workers' competence development and adult education.

In carrying out the above assignments various working tools, methods and approaches can be used. For instance, in defining the occupational profiles and their qualifications computer-aided programs are available. Vocational adult education and training can be arranged for instance through short courses programs, apprenticeship training, on-the-job-training, journeyman-learner learning and learning-by-doing exercises.

In the establishment and implementation of competence development activities the most recommended tools and models are the proposed ECMM model of Nurminen and the Contextual Learning Model of Poikela. The implementation of these models must be done in accordance with the Kenyan sawmilling industry conditions and in accordance with the sawmills participating in competence development. These models can be used for both sawmill enterprises and individuals competence development. In this processes the sawmills and the local training institutions, the FITC and the KFC, have a key role to play.

Through the proposed models the enterprises' and individuals' lifelong learning and competence development can be ensured and, as a result, more competent workers and labour force can be developed and sustained for the Kenyan sawmilling industry.

The KFS carried out the sawmill prequalification process in 2008. In this process competences of the sawmill workers' were not required in order to pass the prequalification. Therefore, it is recommended that the KFS considers again its' sawmill prequalification criterions and requires a certain competences from the sawmill workers. Through these obligatory competence requirements the sawmills would be forced to train and improve their workers competences in order to prequalify. This should at least be the requirement after the first two-year prequalification round. Therefore, it is recommended that the KFS, KFC and FITC establish a sawmillers' "prequalification" certificate course in sawmilling. Through these training and preconditions the KFS would be in a position to further develop the sawmills and would be able to build up records keeping and reporting systems to the sawmills that will enable the KFS to control the sawmills more effectively.

Suggestions for Further Research

This research work and the field survey have brought up new ideas about the researches that could be implemented to support this one and to have more in-depth information about the sawmilling sector, sawmills and their development. These new studies and researches could also facilitate linkage between the KFS, Kenyan forestry and wood industry and the external research institutions and universities like Lappeenranta University of Technology. In this respect the following are the most relevant areas to be studied:

1. ***In-depth study to define the sawmillers' occupational profiles and their qualifications*** to guide establishment of the sawmilling training curriculum.
2. ***Study on sawmills' raw material utilization and the recovery*** to show how much raw material and resources are lost in terms of volume and value.
3. ***Study on use of the sawmills' by products for industrial use or energy production.*** How to utilize sawdust, slabs, off-cuts and bark?
4. ***Study on development of appropriate technologies for use of the sawmills' wood residues***. For instance stoves for households, small scale energy and electricity production for villages and industry and briquetting techniques.

9 SUMMARY

The objective of this thesis was to study and analyze the level of the sawmilling industry in Kenya and to identify sawmill workers' competences and the training needs of the sawmills. In order to do this the technological stage of the sawmills, constraints and factors limiting their production operations and employment as well as the capabilities of their workers were studied and analyzed. In addition to these the existence and level of sawmilling education and training in Kenya were studied, particularly from the adult learner's point of view. The aim of the work was to discover and suggest potential models and practices for the sawmills' capacity building and competence development both at the sawmill enterprise and individuals level. To do these a nationwide field survey was carried out through face-to-face interviews and a structured questionnaire for data collection.

The results indicated that the biggest challenges are in the sawmills' technological development, capacity building and human resources development, particularly in the development of the workers' and managers' competences. If the profitability and viability of the sawmills is to be improved these areas are the first ones to be tackled. This is evident, because only 16% of the sawmill workers had some professional education. These development activities are demanding ones because in Kenya there is no operational institution that offers vocational education or training in sawmilling. However, the sawmillers said and believed that if they are supported through the correct mechanisms, such as training, technical assistance and government financial support, they are willing and able to develop the sawmill enterprises and the sawmilling industry as a whole. In order to improve this situation the technical assistance and extension services directed to the sawmills should be started immediately to be supported with relevant, practically oriented sawmilling training both at the sawmills and at the FITC premises in Nakuru.

I believe that the results of this work, if well interpreted by the KFS, TMA and the sawmills' stakeholder groups, will provide good basis for development. The results of this work should now be thoroughly introduced and discussed with the sawmills and their stakeholder groups in order to facilitate establishment of appropriate competence development programs and capacity building of the sawmills and their workers. To be competitive the Kenyan sawmills need to develop their management procedures,

production technologies, production operations, working methods and processes and especially the personnel at all levels. The development activities should be started by strengthening and starting of the co-operation and co-ordination between the sawmills, TMA, KFS, KEFRI and the training institutions.

Currently in Kenya there is no vocational training in sawmilling, sawmill machine maintenance or sawmill production management. However, there is good evidence that training of workers has a tremendous impact on enterprise profitability and viability. Through training and competence development a growth of 10-20% in productivity can be achieved. This is also needed in the Kenyan sawmills, where productivity and the utilization of raw materials is low. The KFS has a challenge, in particular if the industrial forest plantations are opened up for tenders. In that scenario the KFS needs to be prepared and needs to make sure that sawmillers are provided with backstopping, support and with adequate training, extension services and technical assistance in forestry, sawmilling, production management and other sawmilling related subject matters.

Competence is a combination of knowledge, skills and technologies that are driven by human beings and organizations. In the Kenyan sawmilling industry these must be developed mutually by considering the sawmill enterprises' objectives, technological development and workers' competences. Competence development of the sawmilling industry in Kenya is a big challenge, but so are the development of vocational training in sawmilling and the development of the training institutions like the FITC in Nakuru. FITC must be re-opened, its training activities re-started and the training curriculum in sawmilling re-established. This can only be done sustainably through effective co-ordination and co-operation with all the sawmills and their stakeholder groups.

Competence development of the sawmill enterprises and the individuals can be organized through the proposed ECMM. To achieve the best results, a mutual participatory planning procedure, good coordination and an open environment for discussions, networking and implementation should be secured by all the stakeholder groups. All people working in the forestry sector and sawmilling industry must understand and accept these basic working principles.

The achieved research results were interesting and supported the preliminary assumptions made. They provided various angles and perspectives of the Kenyan sawmilling industry and the constraints and difficulties that the sawmills encounter. By developing the sawmill technologies and workers' competences the sawmills' productivity and operations can be improved, which will contribute to a better working environment, higher raw material utilization and recovery and eventually to more sustainable use of the renewable natural resources. Also, this will contribute to better sawmill competitiveness, an increase in employment opportunities, growth of the Kenya's gross national product (GNP) and eventually to improved social welfare for the families, communities and Kenyan nation as a whole. The development work of the Kenyan sawmilling industry is just a beginning. Such development is very important for the Kenyan nation.

I believe that in this work I managed to approach the research questions from various, relevant and current perspectives. By doing this I was able to answer the set research questions and I managed to create successful conclusions and recommendations for further actions to be taken by the KFS, TMA, the sawmillers and others working with the sawmills. The work has been very demanding and challenging in many ways, but it has also been a good learning process in theory and practical application. The most demanding tasks were the literature review and the entire writing process, which took a major part of the time spent on this work. In all, I would like to say that the whole process has been a very educational, it has taught me a lot and has given me many new experiences. Hopefully, these experiences achieved and lessons learnt can be used for many years to come. The competence development of individuals and human beings is a challenging task. It is a lifelong assignment for all of us and needs to be taken seriously.

On the 6th of August 2008 I wrote a note for my office wall, saying that: ***"One day, my aspirations will be achieved."*** Now, today on the 14th of April 2009 the aspiration becomes a reality. This thesis assignment and the three years of study at Lappeenranta University of Technology will be accomplished and it will be time to look at new challenges both in life and work. With anticipation and a lot of hope, this hard work will hopefully give me some extra strength, benefits and new challenges during the rest of my working career and life. Thank you very much for all who have helped me in the accomplishment of this assignment.

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APPENDICES

Appendix 1. Field Survey Questionnaire.

SURVEY QUESTIONNAIRE ON SAWMILLS' PRODUCTION TECHNOLOGIES, WORKERS' COMPETENCES, QUALIFIACTIONS AND TRAINING NEEDS

1. ENTERPRISE INFORMATION

Name of respondent: _____ Title: _____

Age: _____

Basic education: _____ Years _____

Professional education: _____ Years _____

Experience in field _____ years, of which _____ years in the position of _____

Need for further training or know-how in subject areas: Yes _____ No _____

If yes, what _____

Company name/Plant: _____

Address: _____

Telephone: _____ Fax: _____

E-mail: Internet homepage: _____

2. ENTERPRISE

Sole proprietor		Partnership		Co-operative		Corporation	

a. **Owner**(s)of the mill: _____

b. **Year** of establishment: _____

c. What is the **nature of the business** (major line of business)

2.c.1.	Mobile sawmill	
	Fixed sawmill	
	Furniture and joinery manufacturing	
	Timber selling for domestic markets	
	Timber selling for export markets	
	Planing and moulding	
2.c.2.	Others, what	1. 2.

(Continue)

2.1 What is your opinion about the following statements concerning **production technologies & machines**, **workers competences and technology development**?

(Check the most appropriate point of view, 1 = complete disagree, 2 = disagree, 3 = uncertain, 4 = agree and 5= fully agree).

2. 1. 1. Production technology	**1**	**2**	**3**	**4**	**5**
Our machines are up-to-date					
We only use the latest and the most modern technology					
Our production machines are well maintained					
All machines are in good working condition					
Our machines are old and well maintained					
Our machines are functioning well					
We have better production facilities than our competitors					

2.1.2. Competences to operate the machines	**1**	**2**	**3**	**4**	**5**
We master technology, that we use well					
We don't have any problems to operate our machines					
Our competences of production technologies are good or excellent					
We don't have competencies to master new production technologies					
There is no skilled and well trained labor available for wood production operations					
We don't have well trained personnel to operate the latest technology and the most modern machines					
In case we invest for new machines and equipment we should train our personnel					
It is difficult to survive in the competition if enterprise does not train its personnel					
Without skilled personnel sawmills can not operate profitably					

2.1.3. Technology development	**1**	**2**	**3**	**4**	**5**
We have good understanding of new technologies available					
We know type of technology we should use and purchase					
Production technologies we use are appropriate for the local conditions					
We should purchase new technologies in order to compete					
We don't have competencies to master new production technologies					
We don't have well trained personnel to operate the latest technology and the most modern machines					
In case we invest for new machines and equipment we should train our personnel					
We know that appropriate production technologies keep chancing fast and we should follow the development					
We need to develop our production technologies together with other sawmills					
Networks and co-operations are important to survive in the business					

(Continue)

2.2 Is your **enterprise in networks or co-operation** with other sawmills; wood processing enterprises or service providers and which of the following enterprises are **your business partners**?

Enterprise type	We are business partners with	We have network with	How many agreements you have?
Sawmills			
Sawdoctoring service providers			
Mechanical workshops			
Transport providers			
Financial administration and accounting offices			
Subcontractors			
Suppliers for consumables			
Final customers and end users			
Resellers and dealers			
Research and development institutions			
Training institutions			
Other, what			

3. TECHNICAL BACKGROUND OF YOUR MILL

3.1. **Type of machines** used for sawmilling, sawdoctoring, further processing, sawn timber drying etc?

Indicate section or department	Type of machines or equipment	Age	Is the machine functioning		Years	Condition
			Yes	No		

3.2. How is **maintenance of machines and tools** arranged?

	Yes	No
Daily		
Weekly		
Monthly		
Yearly (annually)		

If no, state the problems: _____

3.3. **Who performs the maintenance/repair**?

	Yes	No
Mechanics		
Sawdoctors		
Operators		
Others, who		

3.4. Do you have any **problems in maintenance or repairs**? Yes ____ No ____
If yes, what _____

(Continue)

3.5. Do you have any **problems in spare parts supply**? Yes ____ No ____

If yes, what _____

3.6. How is **sawdoctoring** of the saw blades arranged?

At the mill by experienced saw doctor? Yes ____ No ____

If no, why? _____

If **external saw doctoring services** are used are there any problems?

_____

3.7. How is **drying of sawn timber** done?

	Yes	No
Seasoning		
Kiln drying		
Not done		

If not done, why _____

4. PRODUCTION

4.1. What are **daily productions** and/or consumption of raw material and sawn timber?

Wood species	Amount/day m3/pcs	Main products/ dimensions, description

4.2. How much of the **products are further processed** and **what products are produced**?

_____

4.3. Are you doing **sorting** of sawn timber? Yes ____ No ____

Yes or no, give some reasons _____

_____

4.4. Are you doing **grading** of sawn timber? Yes ____ No ____

Yes or no, give some reasons _____

(Continue)

4.5. What is the **installed capacity** of the mill?

In put per day / m3 _____ **out put** per day / m3 _____

In put per annum / m3 _____ **out put** per annum / m3 _____

What is the **average recovery rate** of the sawmill? ____ If **lower than 38%**, state problems and reasons for that _____

_____

Is it utilized at the moment? Yes ____ No _____

If no, why _____

4.6. If any, which **factors** below **limit the production operations**?

Sawmill machinery		Raw material		Capital	
Working capital		Price control		Raw material quality	
Sawdoctoring equipment		Competence of workers		Infrastructure	
Transport equipment		Handling equipment		Legislations	
Technical manpower		Space for expansion		Maintenance tools	
Cost of raw material		Availability of raw material		Cost of labor	
Insufficient capacity		Cost of raw material transportation		Market information	
Government regulations		Maintenance of machinery		Spare parts availability	
Office manpower		Casual labors			
Other, what					

4.7. Where are your **main problems in your business**?

	Yes	No
Buying the wood raw material		
Wood harvesting		
Transportation		
Manufacturing		
Financing		
Marketing		
Management		
Exporting		
Others, what		

(Continue)

4.8. Do you have any wood **further processing machines or facilities**?

Planing machine		Woodworking machines		Kiln dryer	
Wood preservation plant		Carpentry workshop			
Others, what?					

5. EMPLOYMENT

5.1. If any, which factors below limit the number of employees in your enterprise?

Sawmill machinery		Raw material		Capital	
Working capital		Price control		Raw material quality	
Sawdoctoring equipment		Competence of workers		Infrastructure	
Transport equipment		Handling equipment		Legislations	
Technical manpower		Space for expansion		Maintenance tools	
Cost of raw material		Availability of raw material		Cost of labor	
Insufficient capacity		Cost of raw material transportation		Market information	
Government regulations		Maintenance of machinery		Spare parts availability	
Office manpower		Casual labors			
Other, what	1. 2. 3.				

5.2. In which **areas you need technical assistance mostly**? Put number 1 for most important, number 2 for second important etc?

	Rate importance	Yes	No
Preparation of feasibility study			
Wood procurement			
Manufacturing / production			
Marketing			
Design of products			
Management of the company			
Other, what 1. 2.			

(Continue)

6. TRAINING

6.1. Which **type of occupations** exist in your sawmill and what type of basic, professional or vocational education or further **training your employees have gone through** and what has been the length of education or training?

Occupation	Number of workers	Basic education	What level of education	Professional education	Further training courses	Apprentice-ship training

6.2. Is there any need for employees' **vocational basic education** or **further training**?

Education type	Management		Workers	
	Yes	No	Yes	No
Basic				
If yes, what?	1. 2. 3.		1. 2. 3.	
Further				
If yes, what?	1. 2. 3.		1. 2. 3.	

6.3. Which of the following **type training** you want for your staff?

Employee	Basic Vocational Education	In-House Training	Short Course Training	Tailor-Made Courses	Apprentice-ship Training
Manager					
Foreman					
Supervisor					
Operator					
Sawdoctor					
Maintenance					
Others (Specify) 1. 2. 3.					

(Continue)

7. LEARNING ORGANIZATION OR ENTERPRISE/ WORKERS KNOWLEDGE, COMPETENCES AND QUALIFICATIONS

7.1. Has your enterprise ever defined the core competences of sawmill and enterprise occupations?

_____

Do you see that it is important in enterprise development? _____

And are you able to do that? _____

7.2. Have your enterprise better professional competences than your competitors?
Yes _____ No _____

If yes, what? _____

7.3. Do you think that your sawmill enterprise can build up the success through a learning organization whereby the most important sources are learning, particularly learning on how to learn new and more complex issues?
Yes _____ No _____

7.4. Answer the following questions about the state of your enterprise.

State of the sawmill	Sub-areas and development areas
1. Which competence sub-areas are the strongest and enterprise can handle well?	
2. Which competence areas or subareas should have special attention?	
3. Which competences areas should be developed first to get best results?	

7.5. Answer the following questions about present situation of enterprise from the learning point of view.

Situation	Comments and ideas
1. Is the enterprise atmosphere favorable and open for learning and development of human resources?	
2. Do the owners and managers know how to develop organization's human resources and are they ready to support individual learning?	
3. Do the owners and manager know that learning of individuals and organization itself must be well managed?	
4. Do you understand enough about the concept of learning organization and are you able to implement it in practice?	
5. Can you estimate present competences and their qualities of the enterprise?	
6. Do you know what competences are required in each section of sawmill and individual occupations?	
7. Do you know who are supposed to be trained, how and when?	

Appendix 2. Letter to Sawmill Owners / Managers

Date: September 30 2008

RE: STUDY ON CAPACITY AND TECHNOLOGY DEVELOPMENT OF SMALL AND MEDIUM SAWMILLING ENTERPRISES IN KENYA

Dear Sir/Madam,

The "Miti Mingi Maisha Bora – Support to Forest Sector Reform in Kenya is a program within the development cooperation between Kenya and Finland. The inception phase of the program is implemented during the period of July 2007 - December 2008. The objective of the program is to facilitate increased contribution of forests and improved forest management for economic recovery and poverty alleviation on economically and socially sustainable basis to improve quality of life in Kenya.

Through the KFS Board, the government of Kenya is now considering deletion of ten years old logging ban. The new Forest Act 2005 and the subsidiary regulation developed under the Act, "The Forest (Participation in Sustainable Forest Management) rules" outlines for the procedure to obtain raw-material from the state plantations through bidding either for timber license or concession arrangements. To be able to participate in the bidding process the sawmill entrepreneurs have to go through a pre-qualification process where their technical and financial capacity is assessed.

The main objective of this study is to assist in capacity and business development of small and medium scale (SMS) sawmills in Kenya. By developing SME sawmills and their activities employment, social and economical conditions as well as living conditions and social welfare will be improved. Therefore, this nationwide survey on SMS sawmilling is organized as to find out and analyze problems, economic activities, interests and training needs of the sawmills. Under the supervision of the director of the Kenya Forest Services, the researcher, Mr. J. Kiuru will implement the following activities:

1. Study and analyze current situation of SMS sawmill enterprises in Kenya.
2. Study and analyze existing problems of SMEs' operations in SMS sawmilling.
3. Determine competence and skills basis of sawmill owners, managers and workers as basis for development of appropriate training.
4. Liaise with the Kenyan SMS sawmills enterprises around Nyeri and Nakuru townships to collect and update enterprise information and training needs requirements.
5. Liaise with the KFS, TMA and KEFRI to obtain earlier collected information and analysis of sawmills, in which also training aspects have been tackled.

(Continue)

6. Liaise with other relevant forest and wood industry institutions in Kenya to gather more information and ideas on human resources competence development and training needs of the field.

A survey questionnaire has been attached to this letter, which will be used to acquire further information about the SMS sawmills in Kenya. The questionnaire requests information about the SMS sawmilling in the following areas:

- Sawmilling, logging, saw doctoring and maintenance technologies applied.
- Number of people working in SMS sawmills.
- Present and future competences required from the sawmill personnel.
- Type of training needed and subject areas required.
- Number of persons to be trained.

With this letter you are kindly asked to assist in our survey to help development of SMEs in sawmilling. By filling this questionnaire you will greatly assist the Kenya Forest Service and individual sawmillers to improve their business. In few days time you will be conducted for a short interview. We hope you have time to fill the questionnaire in advance and you are in a position to meet our team for about one hour further discussions. Thank you for your good co-operation.

Juha Kiuru
Sawmilling Specialist
Lappeenranta University of Technology
Lappeenranta, Finland

Jonah Mbaabu
Forest Officer
Kenya Forest Service
Nairobi, Kenya

Appendix 3. List of Sawmills and Places Interviewed and Visited

LIST OF THE SAWMILLS AND PLACES VISITED DURING THE RESEARCH

Resercher: **Juha Kiuru**

Period: **23.9.2008 - 31.10.2008**

	No.	Sawmill or place of visit	Name of owner / interviewee	Province	District	Town	Sawmill size
Only interviewed	1	Comply	Nilesh Mehta	Rift Valley	Nakuru	Nakuru	large
	2	District Forest Office	N / A	Rift Valley	Koibatek	Koibatek	forest station
	3	Economic Housing Group, Headquarters **(not in survey)**	Charles C. Bengough	Central	Nairobi	Nairobi	
	4	Economic Housing Group, timber further processing /house fabricatio	Emmanuel J. Njau	Rift Valley	Naivasha	Naivasha	
	5	FITC / Training institute	N / A	Rift Valley	Nakuru	Nakuru	
	6	James Finlay (Kenya) Ltd Sawmill	Hugo Douglash-Dufresne	Rift Valley	Kericho	Kericho	medium
	7	Kenya Forest Service	Jonah Mbaabu	Central	Nairobi	Nairobi	
	8	Miti Mingi Maisha Bora project	Thomas Selänniemi	Central	Nairobi	Nairobi	
	9	Kenya Forest College / Training institute	Peter M.	Rift Valley	Kericho	Londiani	
Interviewed and filled the questionaire	1	Agnes Wajiku Sawmills	Harrison K. Karemeri / Simon Karinga Chiera	Rift Valley	Koibatek	Jogoo	small
	2	Baringo Hardware and Spares	Frazer Bomet & brothers / Rueben Bomet	Rift Valley	Koibatek	Koibatek	medium
	3	Biashara Master Sawmills Ltd	Joseph Mwangi Kanyongo/ Francis Macharpa	Rift Valley	Nakuru	Njoro	large
	4	Charles Magiri Kirimi Sawmill	Charles Magiri Kirimi / Paul Koomekirimi	Eastern	Meru	Kibirichia	small
	5	Epharmart Contractors	Martin Nduati Njoroge / same	Central	Nyeri	Nyeri	small
	6	Eureka Timber Enterprises	James Koigo Kitundu / same	Rift Valley	Kericho	Londiani	medium
	7	Kamburi Sawmill	Edwin Kinyua / Augustin Njati	Eastern	Meru	Meru	small
	8	Kingongo Sawmills	Rukwaro Wamatha / same	Central	Nyeri	Nyeri	medium
	9	Mt Kenya Timber Cooperative Society	Mt Kenya Timber Cooperative Society/ Jackson Gacarwa	Eastern	Embu	Embu	small
	10	Mully Timber Sawmill	Daniel Mwaura Muri / same	Central	Kiambu	Limuru	medium
	11	Munjus Timber and Furniture	Patrick Muchunku / Patrick Muchunku	Eastern	Meru	Chuka	small
	12	Najoma Investments	John Gikandi Mangondu / same	Central	Nyeri	Karatina	small
	13	Omega Sawmill Ltd	Godfrey Githugu / Mary Wamburi	Central	Nyandarua	Magumu	medium
	14	Pamwa Timber and Sawmill	Paul Mwangi / Paul Mwangi	Central	Thika	Thika	small
	15	Phypers Enterprise (Kagumo Sawmill)	Joshua W. Wamae / same	Central	Nyeri	Kagumo	small
	16	Rono Sawmills	Francis K. Ronoh / same	Rift Valley	Koibatek	Eldama Ravine	small
	17	Sasumua Sawmills	David Kirubi / same	Central	Nyandarua	Njambini	small
	18	Timsales Ltd	Ashok /same	Rift Valley	Elburgon	Njoro	large
	19	Trans Africa Timber Ltd	Zakayo Maina Waweru /same	Rift Valley	Nakuru	Nakuru	large
	20	Waithaka S/m Ltd	GraceNjeri / Hoswel Kariuki	Central	Thika	Thika	medium
	21	Wiyumiririe	Peter Wachira Kariuki / same	Rift Valley	Uasin Gishu	Timboroa	small
	22	Woodline General Supplies	Samuel Kirenge Kariri / same	Eastern	Embu	Embu	medium

Appendix 4. Photos of the Kenyan Sawmilling Industry and the FITC

Photo 1, typical circular saw machine

Photo 2, typical band saw machines

Photos 3-4, example of poor material handling that results poor quality products

Photos 5-6, examples of saw blade maintenance practices

(continue)

Photos 7-8, examples of good and poor sawn timber drying

Photos 9-10, examples of poor recovery of raw materials at the sawmills

Photos 11-12, Training facilities for sawmilling and sawdoctoring at the FITC in Nakuru