Saimaa University of Applied Sciences
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Natalia Simonova

RESEARCH OF DEMAND FOR SERVICES OF PAPER AND FIBER LABORATORIES

Bachelor's Thesis 2012

ABSTRACT
Natalia Simonova
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Saimaa University of Applied Sciences, Imatra
Technology
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Tutors: Mr Jarkko Männynsalo, MSc, senior lecturer, Saimaa UAS, Mr Tapio Tirri, Director, MUAS Fiber Laboratory

Saimaa University of Applied Sciences has its own paper laboratory in Imatra. The laboratory has equipment for the whole process of papermaking from pulp to printed products. Mikkeli University of Applied Sciences has its own fiber laboratory with pilot-scale research.

The target of this final thesis was to define the demand of pulp and paper industry in the Southern and Eastern Finland for the services of the Paper and Fiber laboratories. Several pulp and paper mills from the regions of Russia located close to Finland were also considered. The attempt was made to look for the small and medium size companies with which it would be possible to develop cooperation and to which the laboratories could produce services.

The study was based on the questionnaire with 12 questions and carried out in 11 forest cluster mills where 12 persons were interviewed.

The result of the survey shows that eight of the companies are interested to buy services from the laboratories. In the future, contact with these companies should be kept in order to collaborate with them.

Keywords: laboratory services, pulp and paper industry, interview, to collaborate

CONTENTS

LIST OF ABBREVIATIONS

The following abbreviations are used later in the report:

Research and Development: R&D

Saimaa University of Applied Sciences: Saimaa UAS

Mikkeli University of Applied Sciences: MUAS

International Organization of Standardization: ISO

Joint Stock Company: JSC

1 INTRODUCTION

The study was commissioned by Mikkeli and Saimaa Universities of Applied Sciences and supported financially by The Center of Expertise in South-East Finland OSKE.

Saimaa University of Applied Sciences has its own paper laboratory in Imatra which is an important part in the education of paper engineers.

Main objective of the fiber laboratory in Savonlinna is improvement and development of processes in the forest industry. Fiber Laboratory is a research unit under the Mikkeli University of Applied Sciences.

The pulp and paper mills from the south and east Finland as well as from the regions of Russia nearest to Finland are welcomed to utilize the capacities of the laboratories in Imatra and Savonlinna. Pulp and paper mills, skilled staff of laboratories, researchers, teachers and students can cooperate in the research and product development for the forest industry using the laboratories' facilities.

The goal of the study is to determine the scope of the small and medium sized forest industry companies which were interested to buy services from the two laboratories. Based on the findings the Saimaa and Mikkeli Universities of Applied Sciences should make decisions how to improve their services and with which companies they should cooperate.

The preliminary research studies forest cluster structure in Finland, and in the south and east Finland, internal structure of pulp and paper mills as well as chemical mills and information on the availability of the laboratories and R&D departments on the mills. In addition, pulp and paper mills of Russia, located in the regions nearest to Finland were reviewed and taken into consideration. Operating principles and equipment of the paper laboratory in Imatra and fiber laboratory in Savonlinna were studied during the preliminary research. As a result of the preliminary research, a plan of the interviews was drawn up.

The sources of the preliminary research are Internet and newspapers. Data for the primary research was collected by face-to-face interviews in the pulp and paper mills as well as via questionnaires via email.

1.1 Structure of the forest cluster in Finland

Finland is the sixth largest in the world for the production of paper and paperboard (Finnish Forest Industries Federation 2011). The forest industry of Finland includes forestry, timber, pulp and paper industries. The forest industry processes renewable natural resources such as Finland's extensive forests which cover 77% of the country's territory. The largest pulp and paper companies such as M-real, Stora Enso, UPM and Ahlstrom are based in Finland.

Forest industry production plants in Finland are divided into the following groups (Finnish Forest Industries Federation 2011):

- Paper mills
- Paperboard mills
- Chemical pulp mills
- Mechanical and semi-chemical pulp mills
- Paper and paperboard converting mills
- Plywood, particle board and fiberboard mills
- Sawmills
- Furniture and joinery industry.

Most of the mills are located in the south and east of Finland

1.2 Forest cluster in the southern and eastern Finland

South and east of Finland are the biggest forest industry production centres in Finland and one of the leading centers in Europe. According to the map (Fig.1.1) by the Finish Forest Industry Federation (2011) most of the Finnish forest industry production plants are situated in the south and east of the country.

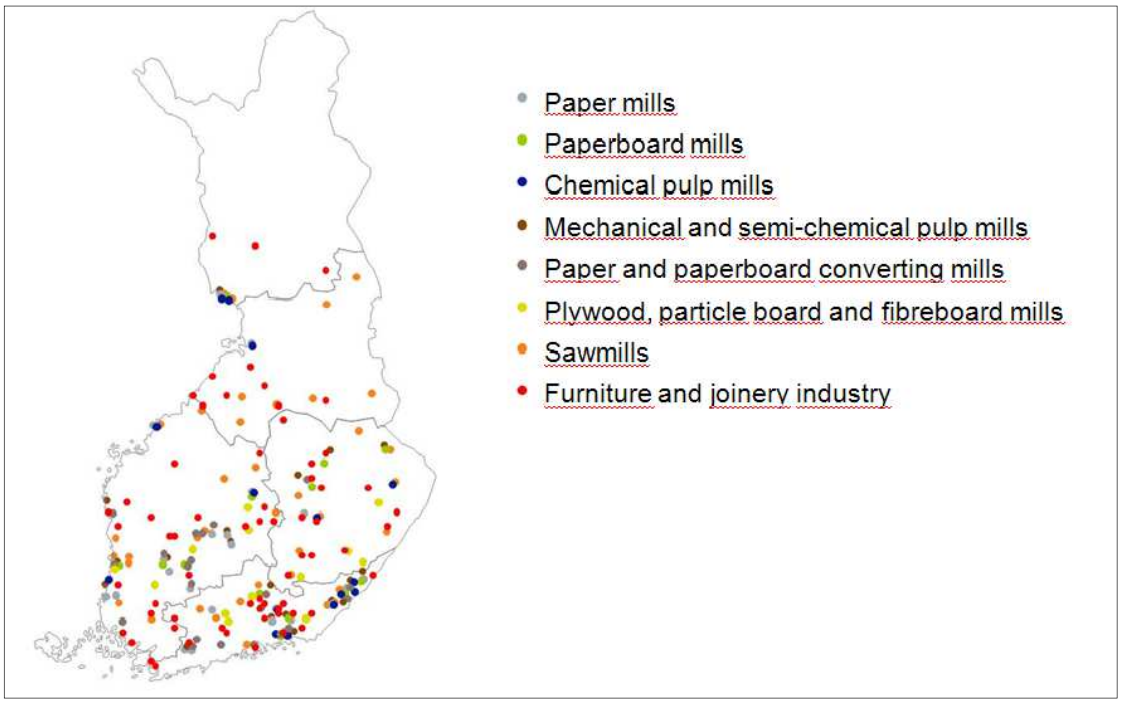

Figure 1.1 Forest industry production plants in Finland (Finnish Forest Industries Federation 2011)

More detailed maps are presented in the figures 1.2 – 1.5 (Finnish Forest Industry Federation 2010 - 2012). The map information indicates that there are 13 paper mills (Fig.1.2), 8 paperboard mills (Fig.1.3), 9 chemical pulp mills (Fig.1.4) and 11 mechanical and semi-chemical pulp mills (Fig.1.5) in the south and east parts of Finland.

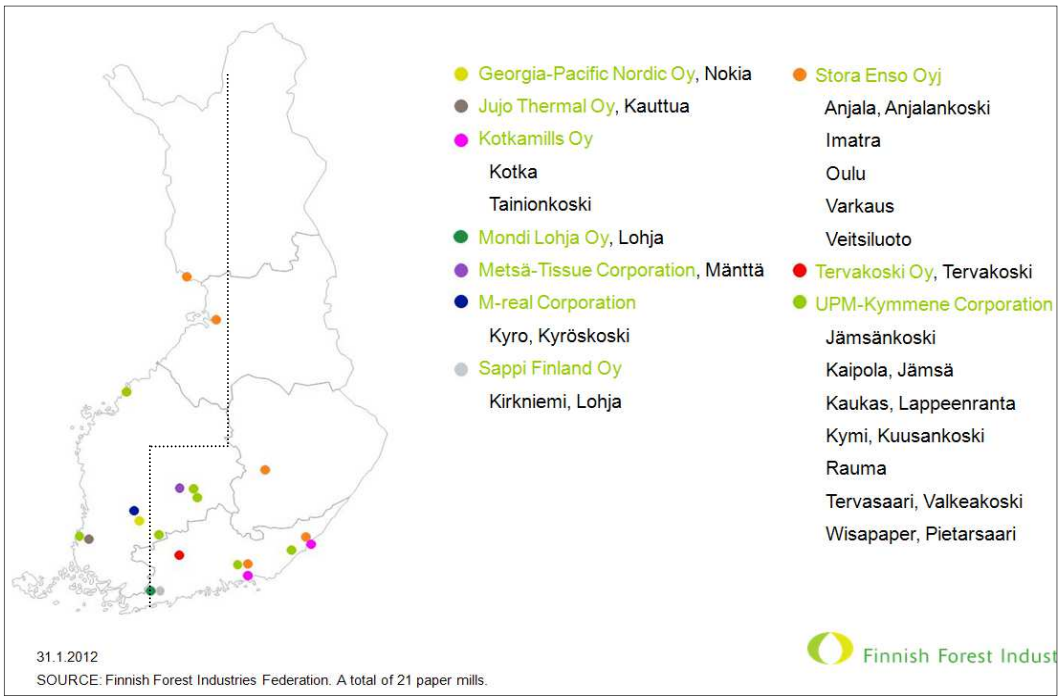

Figure 1.2 Paper mills in Finland (Finnish Forest Industries Federation 2012)

The map information (Fig.1.2) indicates that there are 14 paper mills in the in the south and east parts of Finland. The mills located to the right and below the dotted line were counted.

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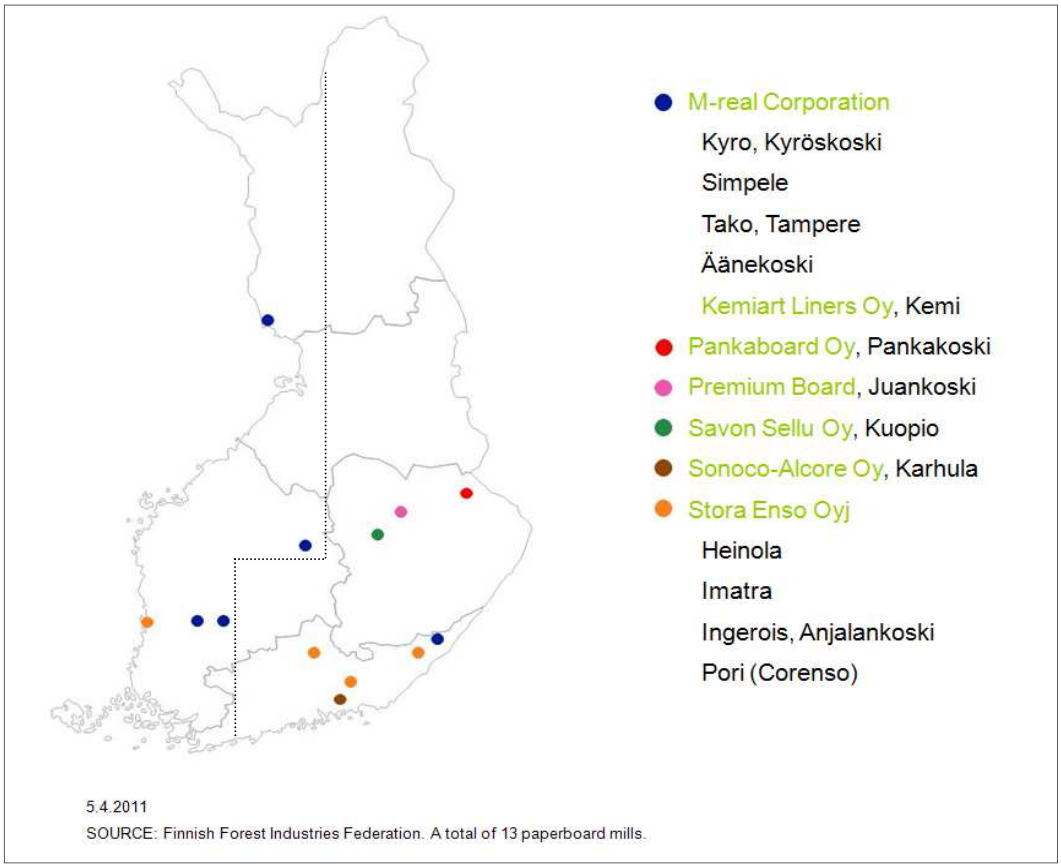

Figure 1.3 Paperboard mills in Finland (Finnish Forest Industries Federation 2011)

The map information (Fig.1.3) shows that there are 8 paperboard mills in the in the south and east parts of Finland. The mills located to the right and below the dotted line were counted.

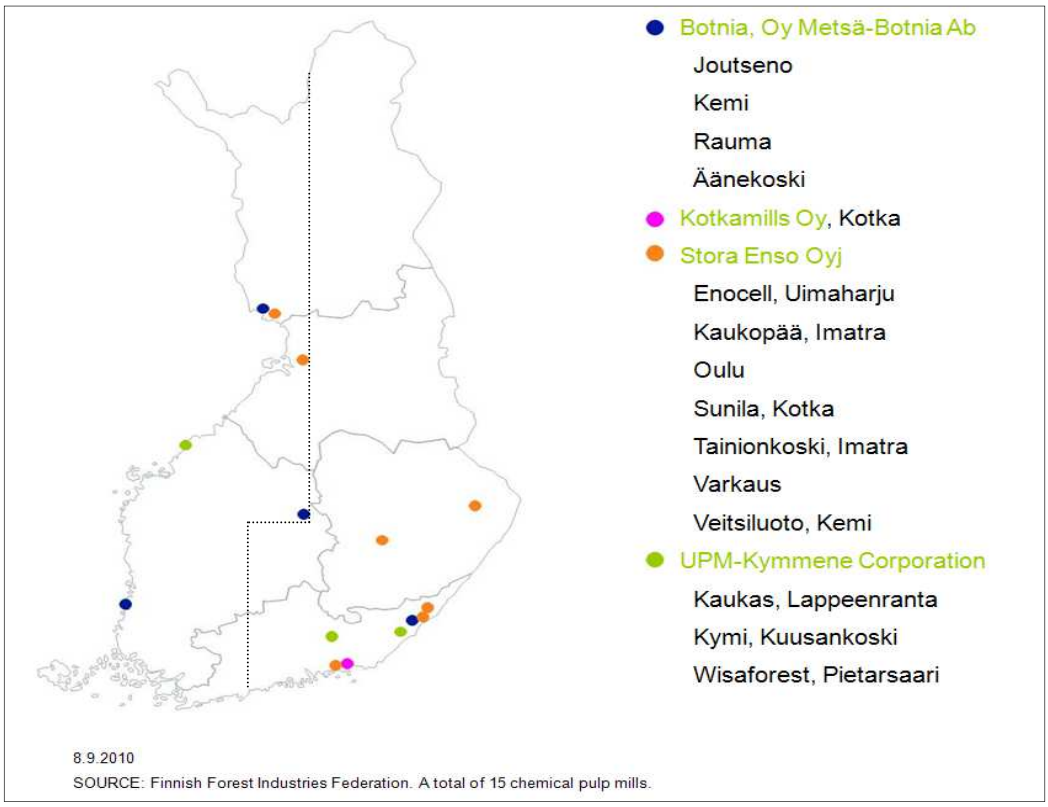

Figure 1.4 Chemical pulp mills in Finland (Finnish forest Industries Federation 2010)

According to the map (Fig.1.4) there are 9 chemical pulp mills in the south and east parts of Finland. The mills located to the right and below the dotted line were counted.

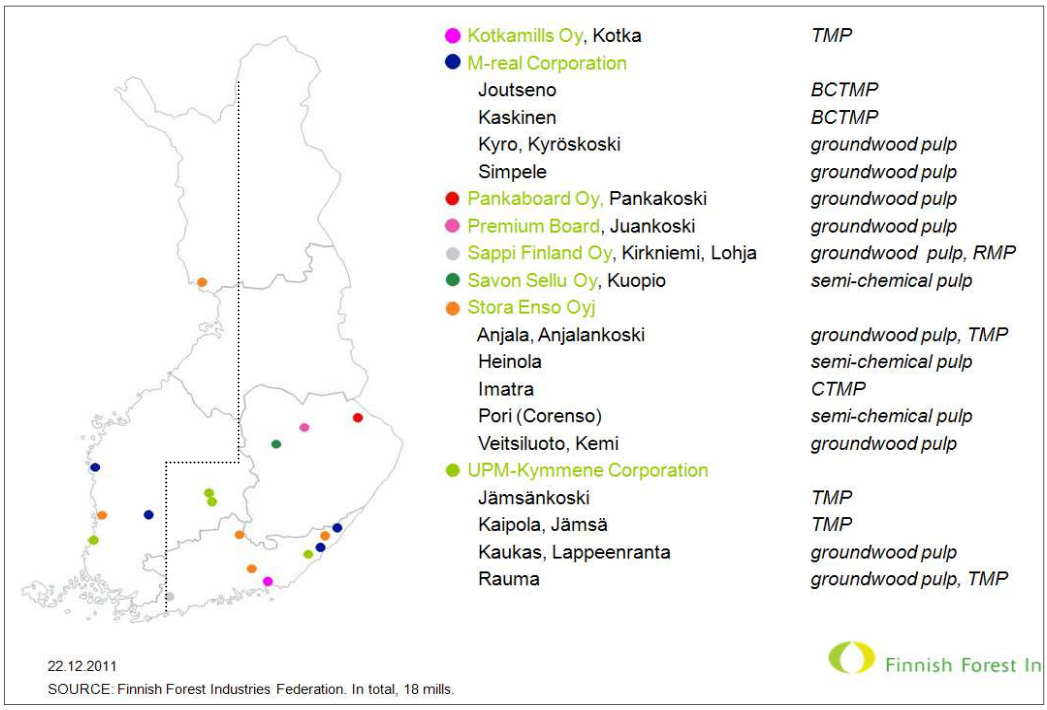

Figure 1.5 Mechanical and semi-chemical pulp mills in Finland (Finnish Forest Industries Federation 2011)

According to the map (Fig.1.5) there are 13 mechanical and semi-chemical pulp mills in the south and east parts of Finland. The mills located to the right and below the dotted line were counted.

1.3 Chemical mills producing chemicals for the pulp and paper industry

The following three chemical mills producing chemicals for the pulp and paper mills in the south and east Finland were taken into consideration: BASF Oy in Hamina, Kemira Chemicals Oy in Joutseno and Nalco Finland Oy in Tesjoki, Loviisa.

BASF Oy plant in Hamina manufactures paper coating dispersions (BASF 2012).

Production of Kemira Chemicals Oy in Joutseno is sodium chlorate, alkali, hydrochloric acid and other chemicals for the forest industry (Kemira 2012).

Nalco Finland Oy in Tesjoki produces process chemicals for developing sheet properties and machine productivity (Nalco Finland Oy 2012).

1.4 Pulp and paper mills in the regions of Russia nearest to Finland

Pulp and paper mills in the regions of Russia nearest to Finland are shown in the map (Fig.1.6).

Figure 1.6 Pulp and paper mills in the regions of Russia nearest to Finland (JSC Vyborgskaja Cellulose 2011)

Svetogorsk pulp and paper mill is a unit of International Paper Corporation. This mill is located a few hundred meters from the Finnish-Russian border. Its operations include three pulp mills, two paper machines and A4/A3 sheeting operations.

JSC Kamennogorskaja Offset Paper Factory in Kamennogorsk is currently undergoing bankruptcy proceedings.

JCS Vyborgskaja Cellulose in Sovetsky of Vyborg district produces unbleached softwood sulfite pulp, flute and paperboard.

Consolidated Paper Mills Ltd. is a Russian production and trade holding company. It includes several pulp and paper mills. The mills are located in the towns of Sokol, Polotnyanyi Zavod, Balakhna and Astrakhan (Fig.1.7). The main kind of Consolidated Paper Mills activity is manufacture of the container boards.

Figure 1.7 Russian Company Consolidated Paper Mills Ltd. in Sokol, Polotnyanyi Zavod, Balakhna and Astrakhan (Consolidated Paper Mills 2011).

1.5 Limitations and final scope of the research

The data for this thesis had to be collected from the small and medium size forest industry mills. Taking into account this limitation the number of the mills where interviews should be conducted was calculated. The pulp and paper mills that were units of larger corporations except the mills in Russia were excluded from the consideration.

As a result the following forest cluster mills were chosen for the research:

- Paper mills:
    - Kotkamills Oy
    - Sappi Finland Oy, Kirkniemi, Lohja
    - Tervakoski Oy, Tervakoski
    - Jujo Thermal Oy, Kauttua
    - Mondi Lohja Oy, Lohja
- Paperboard mills:
    - Adara Pakkaus Oy, Valkeakoski
    - Pankaboard Oy, Pankakoski
    - Premium Board Finland Oy, Juankoski
    - Savon Sellu Oy, Kuopio
    - Sonoco-Alcore Oy, Karhula
- Chemical pulp mills:
    - Kotkamills Oy, Kotka
- Mechanical and semi-chemical pulp mills:
    - Kotkamills Oy, Kotka
    - Pankaboard Oy, Pankakoski
    - Sappi Finland Oy, Kirkniemi, Lohja
    - Savon Sellu Oy, Kuopio
- Chemical mills
    - BASF Oy, Hamina
    - Kemira Chemicals Oy, Joutseno
    - Nalco Finland Oy, Tesjoki, Loviisa
- Pulp and paper mills in Russia:
    - ZAO International Paper, Svetogorsk
    - JSC Vyborgskaja Cellulose, Vyborg district
    - Consolidated Paper Mills Ltd.

1.6 Research methods

The research data from the pulp and paper mills in the east and south Finland was collected through visits to the mills and interviews as well as through questionnaires via email. Taking into account the fact that English is the corporate language on the Finnish forest cluster mills all interviews and questionnaires were carried out in English.

The questionnaires for the Russian pulp and paper mills and experts were prepared in Russian. The research data from the Russian mills was collected through interviews over the phone as well as through questionnaires via email.

The electronic questionnaire was sent to the Active Member of Russian Academy of Natural Science, Doctor of Technical Sciences, Professor Koverninskyi I.N. as an expert in Russian pulp and paper industry. Currently professor Koverninskyi is working as a scientific advisor in the Russian Holding Consolidated paper mills. The professor's answers to the questionnaire were used in the study.

The results were analyzed and illustrated through the tables and charts with use of Microsoft Excel.

2 OVERVIEW OF THE PULP AND PAPER LABORATORY SERVICES

2.1 Importance of the laboratory services for the pulp and paper Industry

The pulp and paper industry is highly competitive and faced with the problems of higher prices for energy and raw material. At the same time, the requirements for paper quality are rising all over the world. It has become increasingly important to reduce manufacturing costs and improve paper quality. Wood products as well as pulp and paper industry require specialized testing and analysis services.

Pulp- and paper-making technologies are changing rapidly. Concern about the environmental impact is changing some of the chemical processes and the chemistry of paper-making. Environmental management is one of the most important aspects in the pulp and paper industry nowadays. More and more common technologies of recycling and de-inking also require laboratory capacities.

Advocates say the demand for recycled paper and sustainably harvested pulp from consumers, advertisers, magazine makers and other users of paper will yield the fastest reforms of the industry (Shapley 2007).

Laboratories of quality control are parts of a quality management system in pulp and paper mills. The ISO 9000 family of standards relates to quality management systems and is designed to help organizations ensure they meet the needs of customers and other stakeholders (Poksinska et al, 2002). The standards are published by ISO, the International Organization for Standardization, and available from the national standards organization in each country.

Over a million organizations worldwide are independently certified, making ISO 9001 one of the most widely used management tools in the world today (Wikipedia 2012).

ISO 9001:2008 is the standard that provides **a set of standardized requirements for a quality management system**, regardless of what the user organization does, its size, or whether it is in the private, or public sector. It is the only standard in the family against which organizations can be certified – although **certification is not a compulsory requirement** of the standard. (International Organization for Standardization 2011.)

2.2 Types of the laboratories at the pulp and paper mills

Two main types of laboratories may exist in the pulp and paper mills. Quality control laboratory monitors quality of raw materials, finished products and emissions from the mill.

Research laboratory implements consistent research and development operations. The laboratory can operate independently or as a unit of R&D department.

Research and Development department is strengthening basic technologies in existing areas, and seeking and developing new fields. R&D may include several research laboratories.

2.3 Availability of Internet Information about the mills laboratory services

Quality control laboratories exist in each pulp and paper mill in Finland and in Russia. Some of the larger plants develop their own research laboratories and R&D departments.

All of the mills in Finland and in Russia provide information about themselves and their products on the web sites. Information on the availability of laboratories and research departments in the mill is often not presented or presented very poorly in the Internet and in the other media.

2.4 Special research centers in Finland

Stora Enso Research center in Imatra develops liquid packaging boards, digital printing, pilot coating, laminating papers and business information. The centre is the main provider of R&D-services for the pulp and paper mills in Finland. (Stora Enso 1999.)

UPM research center provides services for paper production units worldwide. In Finland it is located in Lappeenranta. UPM R&D Center carried out work for paper mills including newsprint, SC, LWC as well as fine and special papers. (UPM Research Center 2011).

VTT Technical Research Centre of Finland operates as a research and development partner in the fields of the forest industry. Forest industry activities cover all branches within the industries, from raw materials to products and processed products including environmental research. (VTT 2012.)

2.5 Special research centers in the Saint-Petersburg region of Russia

Russian Scientific Research Institute of Pulp and Paper Industry (VNIIB) is located in Saint-Petersburg. Research activities of the Institute are related to the creation of new paper and board grades for different industries and to development of environmentally safe, resource-saving technologies for pulp cooking and TCF-bleaching. (VNIIB 2011.)

Bacteriological and chemical analysses of water and wastewater as well as analyses of air emissions are produced by a number of state and independent companies in Vyborg and other districts.

2.5 Foreign research services used by the pulp and paper mills

When it is necessary to conduct special studies larger pulp and paper mills and the mills that are corporations' units use services of foreign research centers. The research center can also be a corporation's unit or independent research center specializing in research for the forest industry.

For example, according to the interview Svetogorsk pulp and paper mill in Russia as a unit of International Paper Corporation uses services of European and North American research centers.

3 STUDIES AT SAIMAA UNIVERSITY OF APPLIED SCIENCES

3.1 Purpose of studies at the Universities of Applied Sciences in Finland

Higher education in Finland is organized into two parallel directions: polytechnic education and university education. Polytechnic education is given by the universities of applied sciences.

At the UAS higher education has a pronounced practical emphasis; the study programs are designed and constantly revised to accommodate the rapidly changing needs of business and industry. At the UAS programs are oriented towards meeting nationwide educational demands or linked to regional development strategies (South Karelia University of Applied Sciences 2008).

3.2 Studies at Saimaa University of Applied Sciences

The Saimaa University of Applied Sciences is an institute of higher education in Southeastern Finland in the cities of Lappeenranta and Imatra. Saimaa UAS offers degrees in five fields. In five degree programmes, all education is conducted in English. There is about 3000 students at the university, 200 of them being international degree students. (Saimaa University of Applied Sciences 2012.)

There are the following Degree Programs in the Unit of Technology in Imatra:

- Degree Program in Process Engineering, Bachelor of Engineering (in Finnish)
- Degree Program in Paper Technology, Bachelor of Engineering (in English)
- Degree Program in Chemical Engineering, Bachelor of Engineering (in English)

The Finnish Degree Program in Paper Technology has two specializations, e.g. Pulping and Papermaking Technology or Process and Paper Engineering.

The International Degree Program in Paper Technology contains specializations on Paper Engineering and Chemical Engineering.

A Bachelor of Engineering in Chemical Engineering can work e.g. as product engineer or product development engineer.

The students learn about the equipment and process of pulping and paper industries, their chemistry and converting of paper and board. The degree program prepares students for working as managers and experts in the chemical process and forest industry (Saimaa University of Applied Sciences 2012).

3.3 Laboratory work as an important part of education in Saimaa UAS

At the beginning of 2006 a new paper laboratory of Saimaa UAS in Imatra with updated equipment and facilities was ready for use by students and researchers. Laboratory work is an important part of professional studies in the Unit of Technology. Students learn main stages of pulping and paper making, wood handling, preparing of process chemicals, making of different grades of pulp, paper hand sheet, drying, coating, printing, product test and analyses in the laboratory.

The learning methods and laboratory work at the Saimaa UAS paper laboratory help students to understand the complete process of pulp and paper making. Laboratory work is usually performed by the group of students that develops their teamwork skills.

3.4 The link between the forest industry and Saimaa UAS

In order to meet the challenges of the future the education programs of Saimaa UAS are continuously updated together with industry and companies. Saimaa UAS cooperates with Stora Enso Oyj, UPM-Kymmene Oyj, which are the world's leading paper and forest productions companies. Saimaa UAS also cooperates with international enterprises specializing in the forest industry services such as Jaakko Pöyry Oyj and PIRA International. Students get opportunities to get the tutorial help, practical training on the mills and they can write their final theses or prepare project work for the forest industry companies.

Saimaa UAS also cooperates with forest industry companies in Russia. One of the partner of Saimaa UAS is Consolidated Paper Mills Ltd., which is a Russian industrial and commercial holding, uniting several pulp and paper mills in different regions of Russia. Practical training and project work may be performed by Saimaa UAS students in Russia.

4 STUDIES AT MIKKELI UNIVERSITY OF APPLIED SCIENCES

Mikkeli University of Applied Sciences (MUAS) is a higher education institution and a key research center in the eastern Finland. One of the goals of MUAS is to develop new technologies, products and services for the forest industry and represent the best expertise in the field on a global scale.

4.1 Studies at Mikkeli University of Applied Sciences

Mikkeli University of Applied Sciences has 8 fields of study which is more than any other Finnish university of applied sciences / polytechnic. Students may choose among 20 degree programs, three of which are in English. There are over 760 new students starting in studies leading to a degree every year, and the total amount of students is about 4500. (Mikkeli University of Applied Sciences 2011.)

Fields of study which include laboratory and research activities of MUAS are: material technology, building services engineering, environmental technology and forestry. The following subjects are studied in MUAS:

- strength calculation and mechanics design in material technology composites and coatings
- wood modification in the field of material technology and environment, the research and development
- practical use and product development of by-product flows
- bioproducts technology
- energy efficiency in building services
- environmental health
- forestry and forestry technology (Mikkeli University of Applied Sciences 2011)

Degree students from the partner institutions and foreign exchange students from all over the world come to study to MUAS.

MUAS provide the students with excellent skill to operate in the international business. The geographical focus of international projects is in Russia and es-

pecially on the Saint-Petersburg region. (Mikkeli University of Applied Sciences 2011.)

4.2 Laboratory and research facilities in MUAS

Laboratory and research facilities in MUAS include:

- Environmental Technology Laboratory
- Fiber Laboratory
- Wood Technology Laboratory
- Building Services Laboratory
- Material Technology Laboratory (Mikkeli University of Applied Sciences 2011)

Fiber laboratory is the only one among other laboratories, which studies pulp and paper technologies.

4.3 The link between forest industry and Mikkeli University of Applied Sciences

One of the goals of MUAS is to develop new technologies, products and services for the forest industry and represent the best expertise in the field on a global scale (Mikkeli University of Applied Sciences 2011).

Laboratory work is a part of the education process. Students study the technologies of reproduction and processing of wood, the use of wood in the building and other industries.

Fiber Laboratory of MUAS makes a significant contribution to the development of pulp and paper technologies.

4.4 Fiber Laboratory in Savonlinna

MUAS Fiber Laboratory is a research unit under the Mikkeli University of Applied Sciences. It carries out research and provides services for the pulp and paper industry. The Laboratory also cooperates with machine and chemical suppliers.

Fiber Laboratory's operation started at the end of 2005 when the new premises were finished. The premises consist of offices for 25-30 persons, 100 m2 of laboratories and a pilot plant of 600 m2 (height 12 m). Today the laboratory employs 21 staff members including researchers and operators.

The activities of the laboratory are aimed at the research in the bio-economy. In addition to the pulp and paper innovation, Fiber Laboratory also participates in the development projects of forest products biorefinery and other new processes.

Operating principle of Fiber Laboratory is presented in the Figure 4.1

Figure 4.1 Operating principle of Fiber Laboratory (MUAS Fiber Laboratory 2011).

New mixing technologies for the chemical pulp & paper industry include:

- Speed-up of mixing processes
- Hydrodynamic phenomena (dispersion, flows, shear forces)
- Process-, surface- and colloid chemistry and reactions
- Chemical mixing
- New methods for mixing measurement

- LC- and MC-, fluid-fluid, gas-fluid…

Fiber-additive concepts:

- Increase of the filler content of paper
- New methods for the processing of filler
- Optimizing the usage of a single additive
- Managing the effects of chemical and physical fiber modifications in pilot- and industrial scale

Separation processes relating to fiber suspension:

- Separation of particles and impurities from fiber flow
- Air and gas removal from fiber-fluid flows
- On-line measurement of washing loss in brown stock washing (MUAS Fiber Laboratory 2011.)

5 EQUIPMENT OF SAIMAA UAS PROCESS AND PAPER LABORATORY AND ITS APPLICATIONS

The new paper laboratory was opened in spring 2006. There are rooms for the individual research and teamwork in the laboratory building. Area of the laboratory is about 1400 square meters. The equipment is on the same level or even newer than used in the mills' laboratories.

Paper laboratory includes the following parts:

- Pilot hall
- Wood handling
- Minerals handling
- Pulping laboratory
- Paper testing laboratory
- Pulp testing laboratory
- Chemical laboratory
- Spectrometry laboratory
- Chromatography laboratory
- Printing room

In the pilot hall a forced circulation digester, pressure grinder, defibration cell, flotation cell for de-inking, refiners and screens are used for the raw material defibration. The equipment for the process of paper-making includes four sheet moulds, dryers, presses, sheet coaters and helicoater is.

Pulp and paper properties such as fiber length, surface charge, optical and strength properties are measured in the testing laboratories with modern measuring instruments.

Spectrometry and chromatography laboratories are equipped with modern testing devices such as Atomic Absorption Spectrophotometer, FTIR Spectrophotometer, UV-VIS Spectrophotometer and Gas Chromatograph.

Technical possibilities of the modern digital printing machine installed in the laboratory, allows creating solutions for various problems related to printing on paper or paperboard. The printing machine is used for research work as well as for internal publications of SUAS.

Tables 1 – 9 in Appendix 1 present all the measuring equipment of Saimaa UAS paper laboratory and its applications.

6 EQUIPMENT OF MUAS FIBER LABORATORY AND ITS APPLICATIONS

Research in the Fiber Laboratory is performed in the pilot plant and laboratory analysis facilities.

6.1 Piloting hall

The core of Fiber Laboratory is the piloting hall where piloting and mill-scale trial runs on pulp can be conducted. The pilot plant consists of different loops: a medium consistency loop, a low consistency loop, a Deculator loop, a Trumpjet Mixing loop, and washing and filtering loops.

Customer’s machine may be tested in the pilot plant by connecting to some of the loops for a trial work.

Tables 1 in Appendix 2 present the Piloting hall equipment of MUAS Fiber Laboratory and its application.

6.1 Analysis laboratory

The analysis laboratory supports the trial runs of the pilot hall as well as serves the research projects and customized services for companies. All basic analyses are carried out according to standardized methods.

There is also specific test equipment in the laboratory such as (MBF- Moving Belt Former) and retention (RPA- Retention Process Analyzer). This equipment is used in research of chemicals mixing in a paper machine. The laboratory also has equipment for researching pulp washer operation (Displacement tester) and disc- and drum filter operation (LEAF-tester) in a small scale.

Table 2 in Appendix 2 presents the scope of analyses and methods carried out by the Analyses laboratory of MUAS Fiber Laboratory.

7 DATA COLLECTION AND PROCESSING

Forest industry mills in the south and east of Finland and pulp and paper mills of Russia, located in the regions nearest to Finland were interviewed. The goal of interview was to determine need for laboratory and research services in the mills.

It was planned to survey 13 Finnish mills, 2 Russian mills and 1 Russian Holding. As a result of the survey 8 Finnish, 2 Russian mills and 1 Russian Holding responded. Table 1 in Appendix 3 presents list of the mills and forms of contacts with the respondents.

The following information was sent to the mills by email for review before the interview:

- Questionnaire
- List of Saimaa UAS Paper Laboratory equipment and its application

- List of MUAS Fiber Laboratory equipment and its application
- Price list of Fiber Laboratory services.

Lists of Laboratories' equipment sent to Russian mills were translated to Russian. Information about price of services was also explained in Russian.

Questionnaires in English and Russian for the mills in Finland and Russia are presented in Appendix 4.

7.1 Availability of laboratories and research facilities in the surveyed mills

All of the surveyed mills have product quality control laboratories with instruments for the analysis of effluents and emissions.

As the Chart 7.1 shows, half of the Finnish and Russian respondents informed about availability of R&D departments on the mills.

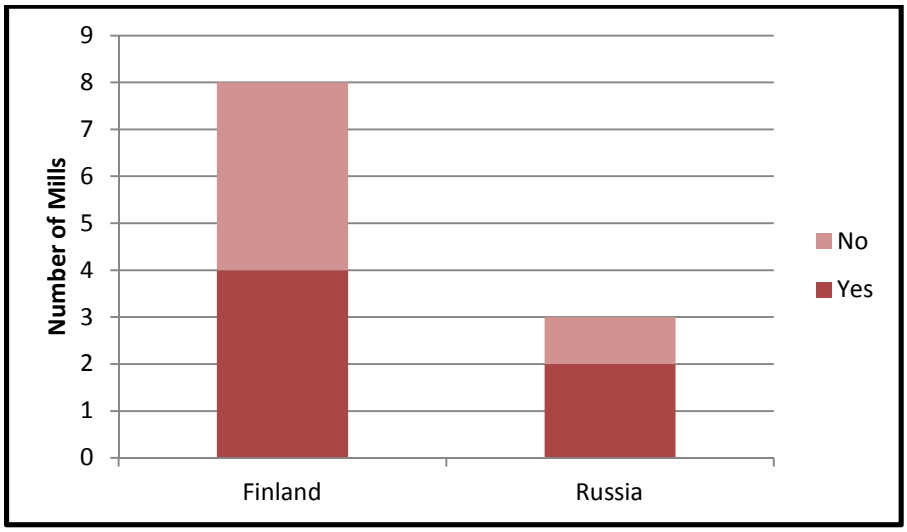

Chart 7.1 Availability of R&D departments on the mills

7.2 The mills' need for the laboratory and research services

The respondents were asked if they use testing and research services of other laboratories and research centers. The answers showed that all of the mills use services of third party laboratories and research institutions. Most part of ser-

vices are regular analyses of effluents and emissions carried out by independent laboratories.

The second question was about the mill's demand in a research work a year. The Chart 7.2 illustrates how often the mills have need for research work.

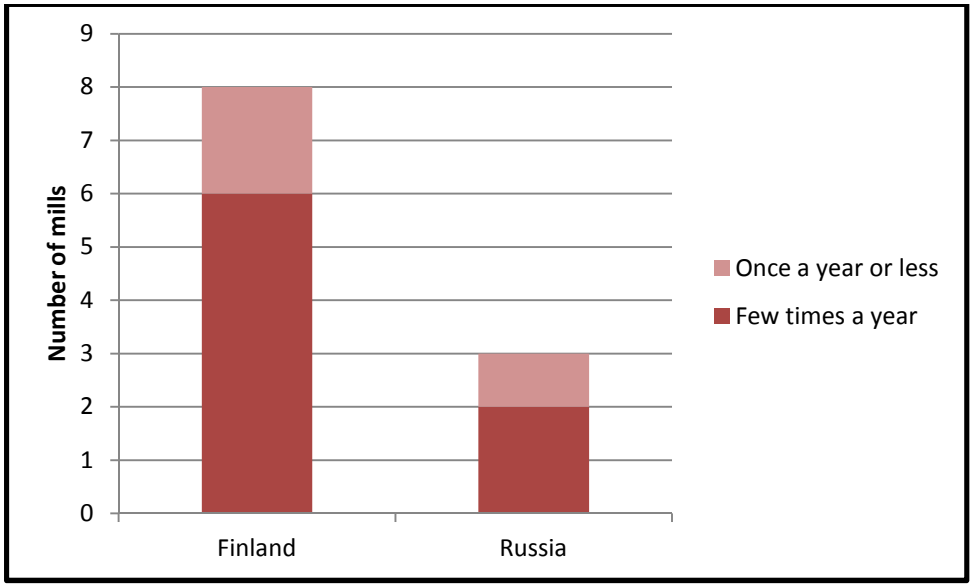

Chart 7.2 The mills' need for research work

As the Chart 7.2 shows half of Russian and a quarter of Finnish forest industry mills need research services seldom. Here the conversation is about the small size mills such as JSC Vyborgskaja Cellulose in Russia or Pankaboard Oy in Finland.

As it was explained by the respondents on the Pankaboard Oy Pankakoski in Finland and JSC Vyborgskaja Cellulose in Russia the technology of paper production nowadays is well established. Emerging problems in the the majority of cases are caused by chemicals used in pulp and paper production so the mills address problems for research to the chemicals producers.

7.3 Types of laboratory analysis and studies required on the mills

One of the interview questions was about the types of laboratory tests and research required on the mills.

All of the respondents reported that laboratory analysis of effluents and emissions were outsourced to independent laboratories. The respondents from all the mills also told that only single study was required. Examples of single study is scanning electron microscope (SEM) analyses or research for the product improvement.

7.4 Mills plans for research

According to the interviews one Russian (JSC Vyborgskaja Cellulose, Vyborg district) and three Finnish forest mills (Pankaboard Oy, Pankakoski; Premium Board Finland Oy, Juankoski; Adara Pakkaus Oy, Valkeakoski) do not have plans for research work in the mill (Chart 7.3). They are small size mills that do not have their own R&D departments. Production problems on the small size mills are normally caused by the process chemicals, so the mills redirect these problems to producers of chemicals.

Such a larger mill as Kemira Chemicals Oy in Joutseno does not have an R&D department on the mill but develops plan for research. Kemira Chemicals Oy in Joutseno as a unit of Kemira Corporation utilizes corporation R&D capacities in Espoo.

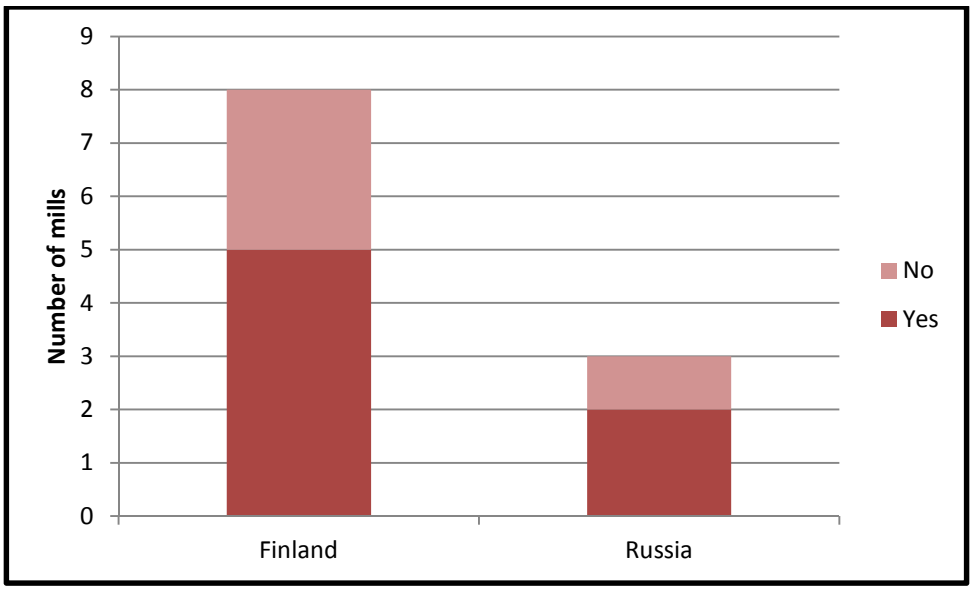

Chart 7.3 Plans for research on the mills

7.5 Important aspects of laboratory and research services

Respondents from both Finnish and Russian forest industry mills were asked on what parameters they choose the services of the third-party laboratories. The Chart 7.4 shows importance of parameters for the respondents when choosing outside research or laboratory services. Importance was calculated as number of references to the parameter divided by total number of respondents.

Respondents told about such crucial parameters as price, services, availability of needed equipment, old links, reliability and knowledge in the forest industry area. According to the Chart 7.4 in most cases, prices and services determine the client's choice.

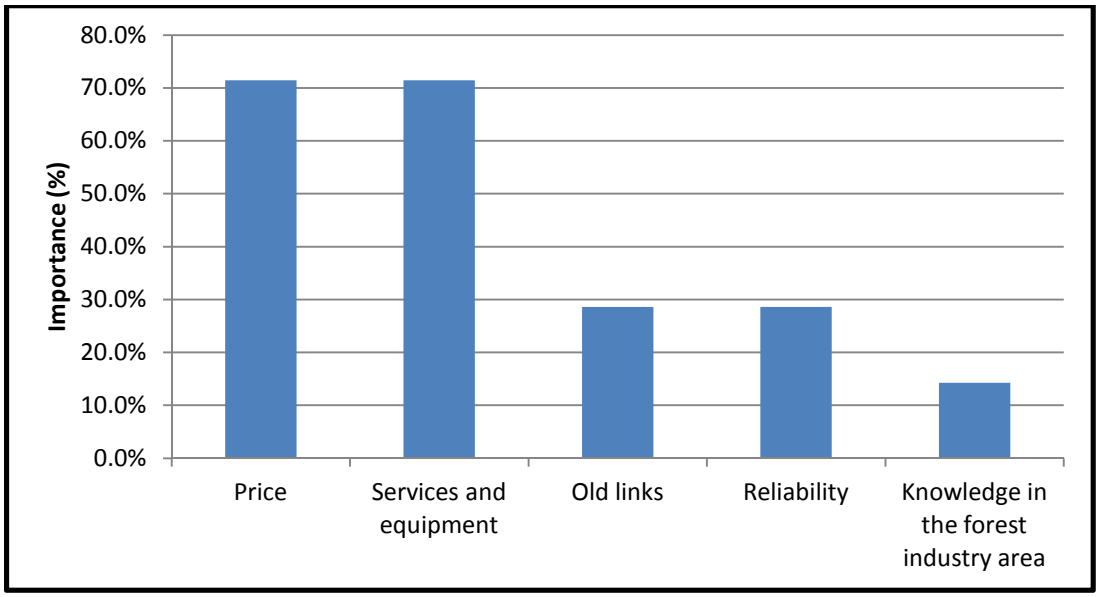

Chart 7.4 Parameters determining the client’s choice of services and laboratories

7.6 Utilizing of foreign research centers

The interview showed that for special studies, larger pulp and paper mills and the mills that are units of bigger corporations utilize services of foreign research centers and corporation’s research institutions abroad which are specializing in research for the forest industry.

Svetogorsk pulp and paper mill in Russia as a unit of International Paper Corporation uses services of European and North American research centers.

Pulp and paper mill Sappi Finland Oy conducts studies in the research center in the South Africa.

7.7 Involvement of students in research

As the survey showed almost all of the Finnish mills invite students for the research and thesis work. The exception was the mill of Premium Board Finland Oy, Juankoski opened in 2011.

Contrary to expectations, pulp and paper mills in Russia do not invite students for the research and thesis work. As Professor Koverninskyi told students were involved in the study only at the mill of Russian Company Consolidated Paper mills Ltd. in Sokol.

7.8 The differences in the laboratory equipment

The interview conducted on the Finnish forest cluster mills showed that the difference in the laboratory equipment in the mills and two Universities' laboratories was not significant.

The uniqueness of the Fiber Laboratory's pilot equipment was emphasized by all respondents.

According to the reply of Professor Koverninskyi the laboratory equipment at the mills of Russian Company Consolidated Paper Mills" Ltd. is very different from the laboratory equipment at the Finnish mills. The professor said that the equipment available at the Russian plants, does not provide reliable results today.

7.9 Possibility of mills' cooperation with Saimaa UAS Paper Laboratory and MUAS Fiber Laboratory

Most interviewed mills were interested in cooperation with Saimaa UAS Paper Laboratory and MUAS Fiber Laboratory. As can be seen in the Charts 7.5 and 7.6 there were 3 types of answers to the question about cooperation with the laboratories.

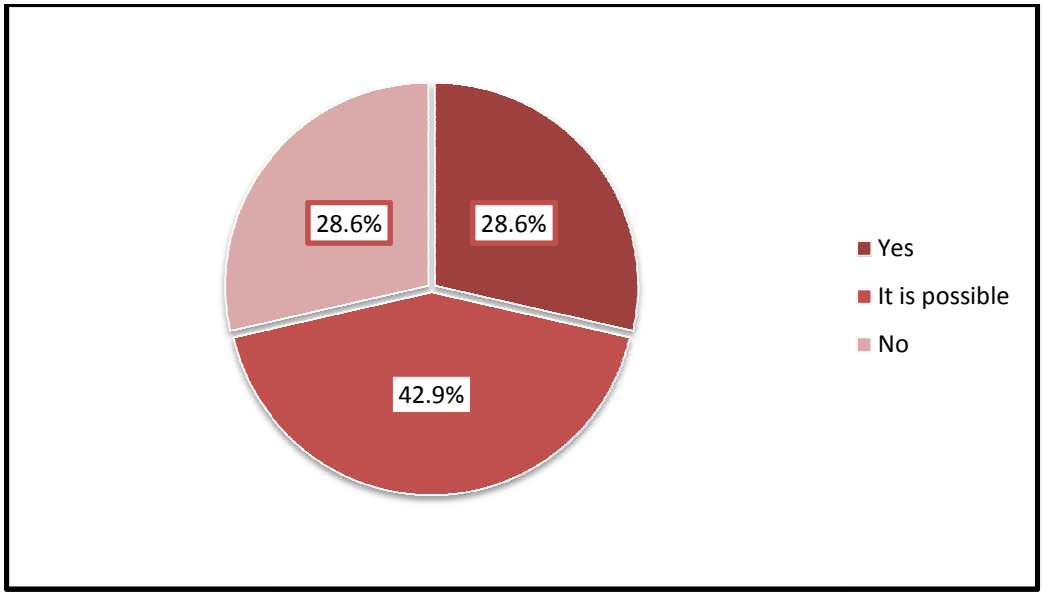

Chart 7.5 Finnish mills' willingness to cooperate with Fiber and Paper laboratories

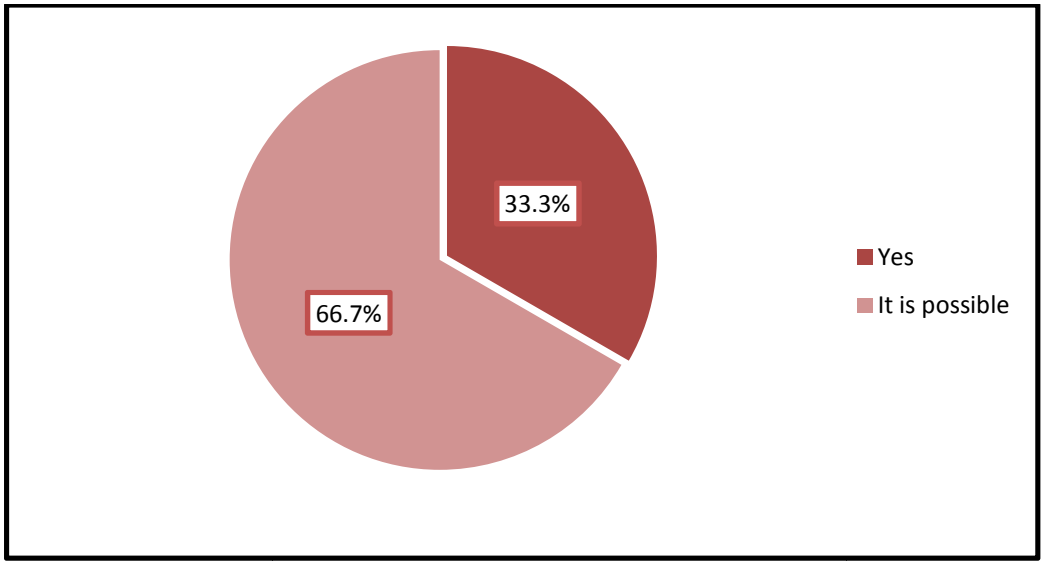

Chart 7.6 Russian mills' willingness to cooperate with Fiber and Paper laboratories

The explanations for answers “No” were given by the respondents from the Finnish mills. Respondents from Sappi Finland Oy, Kirkniemi, Lohja explained their answer by the availability of all research and laboratory facilities in their own mill. The mill Sappi Finland Oy is a unit of Multinational Corporation and conducts studies with the use of Corporation’s research capacities.

Respondent from Jujo Thermal Oy, Kauttua justified the answer in the negative by the fact that Fiber and Paper Laboratories are located too far away from the mill.

Representative of Sonoco-Alcore Oy, Karhula asked if research on the client's algorithm can be carried out in the Fiber and Paper laboratories. Four algorithm sketches of research were presented by him. Analysis of research plan received from the Sonoco-Alcore Oy mill showed that such studies can be performed in both Universities' laboratories.

8 CONCLUSIONS AND RECOMMENDATIONS

The objective of the research was to find out the scope of the small and medium size forest industry companies which were interested to buy services from MUAS Fiber Laboratory and Saimaa UAS Paper Laboratory. Data for the research was collected by interviews in the pulp and paper mills as well as through questionnaires via email. Based on the findings the Saimaa and Mikkeli Universities of Applied Sciences should make decisions how to improve their services and with which companies they should cooperate.

In general, most mills have responded to the request for an interview, and their representatives answered to the interview questions. Responses were not received from some of the mills despite the fact that requests for interviews were sent there several times by email and by phone.

The results of the study show that possibility of using of MUAS and Saimaa UAS laboratory services by pulp and paper mills exists, although the mills do not need those services at the moment. Finnish and Russian mills which were interested in cooperation with the Fiber and Paper Laboratories are listed in the Table 1 of Appendix 5.

Nowadays Finnish forest industry mills have a stable relationship with testing laboratories and research centers. Bigger mills have their own research laboratories or use research capacities of corporation centers in Finland and abroad.

A number of well-equipped independent laboratories and centers exist in Finland, and therefore it is harder to sell laboratory services here.

It was found out that laboratory facilities at the medium and small size mills in Russia do not have a modern laboratory and research equipment at the present time. Thus more attention should be paid to Russian market of laboratory and research services in order to get future partners among the forest cluster mills.

Currently small size mills' using of outside research laboratory services is insignificant. Production problems on the small size mills are usually caused by the process chemicals, so the mills redirect these problems to producers of chemicals. Themes of research appear at the small size mills from time to time, and therefore it is reasonable for the Fiber and Paper Laboratories to maintain contacts with such companies.

The Fiber and Paper laboratories are not able to give full picture of services unless they do not have their own Internet sites with detailed description of each service and equipment. Paper Laboratory of Saimaa University of Applied Sciences does not have own web page or other detailed information in Internet at the moment. Brief Information about services and equipment of MUAS Fiber Laboratory is available on the Internet site of Mikkeli University of Applied Sciences (MUAS Fiber Laboratory, 2012). Detailed but outdated description of MUAS Fiber Laboratory services and facilities is given on the Internet site of Lappeenranta University of Technology (LUT Fiber Laboratory, 2011).

Laboratories have to produce services and also to inform potential clients about their benefits, as well as to achieve precise positioning of their services in the minds of clients. To do this, laboratories must make the best use of such means as advertising, sales promotion and public relations.

In the present market information is becoming increasingly important. The more relevant information, the faster and more rational decisions can be made by potential clients. The speed of delivery and quality of information for consumers can be significantly improved through the use of Internet and other marketing efforts such as publications in the media.

Also examples of solutions, research and thesis works produced in the laboratory may be presented on the web pages and publications.

A thesis written for the pulp and paper mills with use of MUAS and Saimaa UAS laboratories equipment is a higher level of student activity combining research and laboratory work. It allows students to test their skills and take steps towards better understanding of pulp and paper industry processes. Quality thesis work raises the standard and reputation of laboratory and causes increased interest in the laboratory.

At a time when the geographical focus of international projects of Paper and Fiber laboratories is on Russian pulp and paper mills, information on the laboratories' Internet pages should be also given in Russian.

Methods of testing and research used in the Paper Laboratory of Saimaa UAS must be standardized according to ISO standards or other certificates. Information about standards and prices should be published. It is also important to inform clients what kind of staff will perform tests and experiments.

Further study is required to find out which marketing methods should be used by the laboratories to attract customers. Situation on the market of laboratory services in Finland and Russia has to be followed all the time to ensure progress in use of the laboratories.

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APPENDICES

Table 1. Pilot hall equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Pressure grinder	Preparation of groundwood
Refiner	Defibering of chemical pulp, preparation of mechanical pulp
PFI-refiner	Beating of chemical and mechanical pulp
Valley beater x 2	Beating of pulp
Flotation cell	Deinking
Somerville screen	Shives separation, shives content
Bauer McNett	Fractionation and analysis of fiber length
Sheet moulds x 2 (KCL type)	Preparation of paper sheets, fresh water and circulation water systems
Sheet moulds x 2 kpl (Rapid-Köthen type)	Preparation of paper sheets, fresh water and circulation water systems
Vacuum sheet dryer x 2	Drying of paper sheets
Sheet drum dryer	Drying of paper sheets
Quick dryer	Drying of paper sheets
Sheet press	Pressing of sheets
Schopper-Riegler tester	Drainage measurement
Canadian Standard Freeness tester	Drainage measurement
Helicoater coating machine	Blade and spray coating of paper
Sheet coater	Coating of paper
Evaporator	Liquid concentration
Distillation column	Separation of volatile liquids
Filter press	Filtering of slurries
Pressure filter	Filtering of slurry and pulp, fibre recovery
Steam generator 3 bar	Production of steam
Water purification equipment (RO)	Preparation of ultra pure water (reverse osmosis)
Hydrocyclones	Classicication of solids
Plate heat exchanger	heat transfer liquid/liquid
Pulp drying centrifuge	Drying of pulp

Table 2 Wood Handling Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Chipper	Chipping of wood
Gyratory Chip screen	Screening of pulp
Revolving saw	Preparation of samples for pressure grinder

Table 3 Mineral Handling Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Rod/ball mill	Grinding of minerals
Sieve series	Analysing particle size of minerals
Pneumatic classifier	Classification of minerals
Jaw crusher	Crushing of minerals

Table 4 Pulp Handling LaboratoryEquipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Oxygen reactor	Oxygen delignification (pulp bleaching)
Water bath	Bleaching of pulp
Forced circulation digester 10 L	Pulp production
Titrator	Titration
Serial batch digester (8 batch)	Preparation of chemical pulp
Revolving digester 10 L	Production of chemical pulp, impregnation of liquids (CTMP)
Refridgerator	Storage of samples
Deep freezer	Storage of samples
Cold storage room	Storage of samples

Table 5 Paper Testing Laboratory Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Cobb measuring device	Paper/board testing, absorption
Stiffness analyser	Paper/board testing
Klemm instrument	Paper/board testing, absorptio
Tensile strength analyser	Paper/board testing
Cutters	Cutting of paper
Tearing strength analyser	Paper/board testing
Bursting strength analyser	Paper/board testing
Scott-Bond tester	Paper/board testing, z-direction strength
Standard condition room	Maintaining conditions to meet the standard
Gloss analyser	Paper/board testing
Oven	Drying of samples
Fume cupboard	Elimination of hasardous gases
Brigthness/opacity analyser	Paper/board testing
Bendtsen-instrument	Paper/board testing, porosity
Caliper instrument	Thickness of paper/board
Light board	Visualisation of paper samples
Weigh x 2	Weighing samples
PPS measuring equipment	Paper/board testing, microporosity
PC	Reporting

Table 6 Pulp Testing Laboratory Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Turbidity analyser	Characterisation of solutions
Particle size analysser, PAMAS	Single particle counter
Fibre length analyser, FS-300	Analysis of fibre length and curl
zeta-potential analyser	Analysis of surface charge of fibres
Dynamic Drainage Jar	Retention measurement
microscope x 2	Visualisation of samples
Incinerator oven	Dehydration of samples
PC	Reporting
Infrared dryer x 2	measurement of dry content of samples
Weigh	Weighing of samples
Rapid ash analyser	Ash content of paper/board

pH equipment	Measurement of acidity
Contact angle analyser	Paper/board testing
Viscosimeter x 2	Measurement of viscosity
Dynamic water retention analyser for coating colours, ACA	Measurement of dynamic water retention properties of coating colours
Sentrifuge with wire bottom cups	Measurement of water retention value of pulp
Oven	Drying of samples
Sentrifuge	Treatment of samples, measurement of water retention of pulp
Wet disintegrator x 3	Disintegration of pulp
Charge demand analyser	Measurement of charge of dissolved and colloidal substances
Titrator	Titration
Fume cupboard	Elimination of hazardous gases

Table 7 Chemical Laboratory Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Ultrasound washer	Cleaning
pH instrumenti	Measurement of acidity
Fume cupboard x 4	Elimination of hazardous gases
Oven x 2	Drying of samples
PC	Reporting
Heating bath x 5	Heating samples
Reactor with mixer	Research of chemical reations
Weigh x 2	Weighing samples
Water bath	Treatment of samples
Refractive index instrument	Measurement of refractive index on liquids
Melting point instrument	Definition of melting points of solids

Table 8 Spectrometry Laboratory Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Atomic absorption spectrophotometer	Analysis of metal concentrations
Fume cupboard	Elimination of hazardous gases
Weigh	Weighing samples
FTIR spectrophotometer	Identification of organic compounds
UV-VIS spectrophotometer	Quantitative analysys of solutions

Table 9 Chromatography Laboratory Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Fume cupboard	Elimination of hazardous gases
Gas chromatograph	Chemical analysis of gases and volatile liquids

Table 10 Printing Equipment and its application in the Saimaa UAS Paper Laboratory

Equipment	**Application**
Digital printing machine	Production of publications and printed materials
Auxiliary equipment	post treatment of printed material, cutter, binding machine
Fume cupboard	Elimination of hazardous gases
Light board	Visualisation of paper samples
Microscope	Visualisation of samples

Table 1 Piloting hall equipment and its application in the MUAS Fiber Laboratory

Equipment	**Application**
30 m^3 storage tanks	- Forest industry - Technology producers in the forest industry - Producers of measurement, automation and control systems - Process industry - Fluid dynamic and heat transfer technology applications (e.g. heat exchangers, piping flows) - Water handling applications (for example filtration)
Pulper	
Pressure screen	
MC-technology	
Transformer (2MW) for high powered equipment	
Docking station for equipment installation	
Motors equipped with frequency converters	

Table 2 Scope of analyses and methods in the Analyses Laboratory of MUAS Fiber Laboratory

Basic analyses	Method
Water/filtrate analysis	
pH	ISO 6588-1981
Conductivity	ISO 6587:1992
Colour	Merck Spectroquant NOVA 60
COD	Merck Spectroquant NOVA 60
Chlorate	ISO 3199
Turbidity	Hach 2100 AN ISO
AOX	Hach 2100
Spectrophotometer	Merck Spectroquant NOVA 60
Analysis and properties of pulp	
CSF	ISO 5267/2, T 227
SR-number	ISO 5267-1
Consistency	ISO 4119:1996
Dry content	ISO 638:1978
Hot/cold disintegrator, homogenization	ISO 5263, SCAN-M1
Pulp beatin	Valley-Hollander
Somerville	T 275 sp-98T 213, T 437
Dirt count	standard
Dirt count in light table	SCAN-M6:69, T 233
Bauer McNett	Kajaani FS300
Fiber analyser	ISO 302: 1981
Kappa number	
Sheet from the pulp	
Sheet	ISO 5269-1, SCAN-CM 26
Sheet with water circulation	
Drainage/filtration/washing	
Leaf-test cake test	Internal method
Leaf-test saveall	Internal method
Displacement	Internal method
Retention and chemical testing	
RPA (Retention process analyzer)	Internal method
Viscosity	Brookfield
Viscosity, capillar	ISO 5351-1:1981
Particle charge analyzer	Mütek
WRV	ISO 23714Mütek SZP-06
Zetapotential measurement	

Table 2 Scope of analyses and methods in the Analysis Laboratory of MUAS Fiber Laboratory (completion)

Basic analyses	Method
Paper Testing	
Formation	Ambertec
Basis weight and thickness or density	ISO 5270
Tensile strength	EN ISO 5270
Tearing strength	EN ISO 5270,EN ISO 1924-2
Brightness stability	UV-light: Q-SUN Xe-1
Air resistance, (Gurley) Bendtsen	EN ISO 5270, ISO 5636-5
Ash content	ISO 1762, T211
Optical measurements	
Opacity ISO-brightness Yellowness Light scattering Absorption factor Y-value Colour	Elrepho

Table 1 The forest industry mills in Finland and Russia chosen for the Thesis research

Name of the mill	**Mill's response to the interview request**	**Form of contact**
Adara Pakkaus Oy, Valkeakoski	Yes	Telephone, Email
Kotkamills Oy	No response	Telephone, email
Sappi Finland Oy	Yes	Visit
Tervakoski Oy	Yes	Email
Jujo Thermal Oy	Yes	Email
Mondi Lohja Oy	No response	
Pankaboard Oy	Yes	Visit
Premium Board Finland Oy	Yes	Visit
Savon Sellu Oy	No response	
Sonoco-Alcore Oy	Yes	Email
BASF Oy, Hamina	No response	
Kemira Chemicals Oy, Joutseno	Yes	Email
Nalco Finland Oy, Tesjoki, Loviisa	No response	Email
ZAO International Paper, Svetogorsk, Russia	Yes	Email
Consolidated paper mills Ltd., Russia	Yes	Email
JSC Vyborgskaja Cellulose, Russia	Yes	Telephone

Questionnaire for mills in Finland:

1. Does the mill have R&D department?
2. What kind of laboratory (control or bigger laboratory) does the mill have?
3. What kind of research could be made using mill's facilities?
4. Does the mill use services of the other laboratories? What kind of services?
5. How often does need for the research appear in the mill?
6. What kind of laboratory tests and research are performed on the mill's laboratory equipment: regular analyses or single study?
7. Does the mill have plans for research?
8. According to what parameters (price, reliability, old links) are the third party research laboratory/services chosen?
9. Are services of foreign research services utilized by the mill?
10. Does the mill attract students for the research and thesis work?
11. Is there difference in the equipment used for analyses in the two above mentioned Universities laboratories and laboratories of your mill?
12. Based on the review of the SUAS Paper Laboratory and MUAS Fiber laboratories services is it possible for the mill to cooperate with them?

Questionnaire for mills in Russia:

1. Имеется ли на Вашем ЦБК научно-исследовательский отдел?
2. Какой вид лаборатории есть на ЦБК (лаборатория контроля качества или специализированная исследовательская лаборатория)?
3. Какие лабораторные анализы проводятся на ЦБК средствами собственных лабораторных мощностей?
4. Привлекаются для исследований мощности сторонних лабораторий (в России и за рубежом)?
5. Как часто проводятся научно-исследовательские работы на ЦБК, для нужд ЦБК?

6. Какой вид лабораторных анализов производится на лабораторном оборудовании ЦБК (регулярные или разовые анализы или исследования)?
7. Разрабатываются ли на ЦБК специальные планы исследовательских работ?
8. В соответствии с какими параметрами осуществляется выбор сторонних лабораторий (цена, надежность, репутация, старые производственные связи)?
9. Привлекает ли ЦБК студентов для проведения научно-исследовательских работ или работы в лабораториях?
10. Сильно ли отличается оборудование Лаборатории Бумаги в Иматре и Лаборатории Волокна в Савонлинне от оборудования Лабораторий Вашего комбината?
11. Отличаются ли методы, используемые при производстве анализов в двух вышеозначенных Лабораториях и Лабораториях Вашего ЦБК?
12. Основываясь на обзоре лабораторных услуг Лаборатории Бумаги в Иматре и с Лаборатории целлюлозных волокон в Савонлинне возможно или целесообразно ли сотрудничество Вашего ЦБК с данными лабораториями?

Table 1 Mills interested in cooperation with MUAS Fiber Laboratory and Saimaa UAS Paper Laboratory

	Name of the mill
1	Adara Pakkaus Oy, Valkeakoski
2	Pankaboard Oy
3	Premium Board Finland Oy
4	Sonoco-Alcore Oy
5	Kemira Chemicals Oy, Joutseno
6	ZAO International Paper, Svetogorsk, Russia
7	Consolidated Paper Mills Ltd., Russia
8	JSC Vyborgskaja Cellulose, Russia